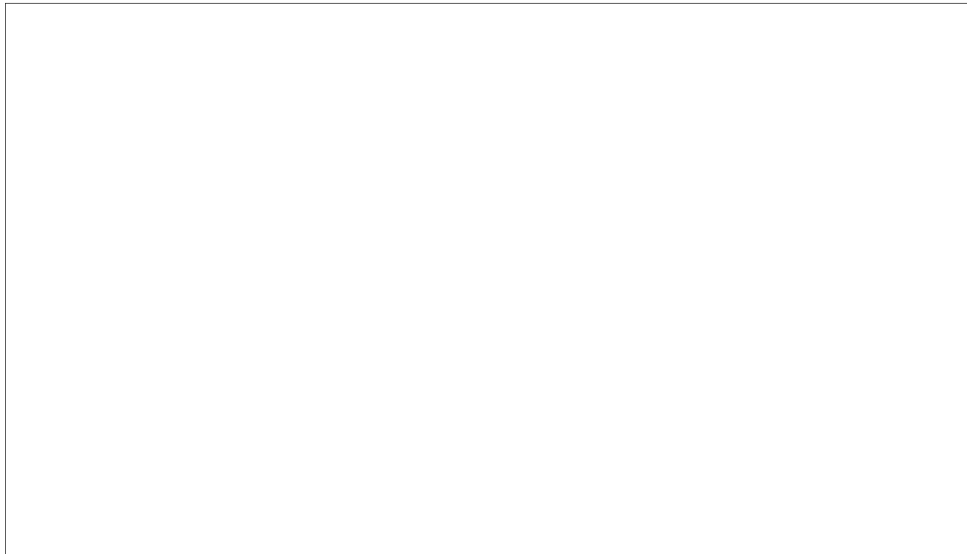


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JCS review completed.

ARMY and DIA review(s) completed.

APPENDIX A

THE LOGISTIC SUPPLY OF VIET CONG AND NORTH VIETNAMESE FORCES
IN SOUTH VIETNAMI. Daily Supply Requirements

Viet Cong and North Vietnamese (VC/PAVN) regular combat forces in South Vietnam were estimated on 24 February 1966 at approximately 72,500 men, including 12,500 PAVN, 43,000 Viet Cong in the main force, and about 17,000 Viet Cong in separate companies and platoons in the local forces. Only the 55,500 troops (111 battalion equivalents of 500 men each) of the main force are believed to receive significant logistical support from external sources. Therefore, the logistic requirements for both external and internal support discussed in this Appendix pertain only to the 111 VC/PAVN main force battalions. The logistic impact of the introduction of 120-mm mortars into main force units and the use of PAVN antiaircraft artillery units in South Vietnam is not considered in detail in the following discussion. Taking such factors into consideration would require field reporting on ordnance expenditure which is not yet available.

The logistic requirements for three possible situations are considered: (1) the present level of the main force and the present level of combat, in which each battalion is assumed to fight about once in every 35 days; (2) the present level of the main force and escalated combat in which each battalion is assumed to fight once in every 7 days; and (3) the main force increased to 155 battalions each of which is engaged in combat once in every 3 days. The level of combat under the first situation is that prevailing during most of 1965. Under each situation a battalion is assumed to expend one-third of its basic load of ammunition during each day of combat. The estimated basic load of ammunition of a Viet Cong infantry battalion is 7.9 tons.* The weapons of the battalion include rifles, carbines, light machinegun/assault guns, 12.7-mm machineguns, 57-mm recoilless rifles, 40-mm rocket launchers, 60/61-mm mortars, and 81/82-mm mortars. Of the total basic load of 7.9 tons of ammunition, more than 4.9 tons are required for the 12.7-mm machineguns. The remaining 3 tons are fairly well distributed among the other weapons organic to the battalion. The number of rounds per weapon varies from 5 for each rocket launcher and 40 for each rifle and carbine to 1,760 for each 12.7-mm machinegun and 2,160 for each light machinegun. This does not seem to be a particularly generous ammunition allowance.

Daily logistic requirements for the VC/PAVN main force battalions under the various assumptions listed above are summarized in Tables A-1 through A-3.**

* Tonnages in this Appendix are given in short tons.

** Text continued on p. A-5.

JCS review completed.

ARMY and DIA review(s) completed.

A-1

Table A-1

Logistical Support for the Current Communist Main Force in South Vietnam
Under the Current Scale of Combat a/

			Short Tons per Day
Class of Supply	Requirements Supplied from Sources Within South Vietnam	Requirements Supplied from Sources Outside South Vietnam	Total Requirements
Class I (food)	55.5 <u>b/</u>	Negl.	55.5
Class II (quartermaster) and Class IV (weapons)	1.6 <u>c/</u>	3.7	5.3
Class III (POL)	1.4	Negl.	1.4
Class V (ammunition)	Negl.	8.3	8.3
Total	<u>58.5 d/</u>	<u>12.0</u>	<u>70.5</u>

- a. A total of 111 battalions (86 Viet Cong, 25 PAVN) of 500 men each. Each battalion is engaged in combat once in every 35 days.
- b. Calculated on the basis of two pounds of food per man per day, known from captured documents to be the VC/PAVN planning figure.
- c. Quartermaster supplies only.
- d. The 17,000 Viet Cong in the local forces require an additional 20.5 tons per day of logistic support from sources within South Vietnam. These local forces are assumed to be self-supporting and to obtain all their requirements for food, quartermaster supplies, weapons, and ammunition from indigenous sources. Although most of these troops are not equipped with the new family of 7.62-mm weapons, there have been indications that some units are beginning to be so equipped. If this is the case the requirement for these forces would be increased slightly and they would have to depend to some extent on logistic support from external sources.

Table A-2

Logistical Support for the Current Communist Main Force in South Vietnam
Under an Escalated Scale of Combat a/

Class of Supply	Short Tons per Day		
	Requirements Supplied from Sources Within South Vietnam	Requirements Supplied from Sources Outside South Vietnam	Total Requirements
Class I (food)	55.5 <u>b/</u>	Negl.	55.5
Class II (quartermaster) and Class IV (weapons)	2.8 <u>c/</u>	23.0	25.8
Class III (POL)	1.4	Negl.	1.4
Class V (ammunition)	Negl.	41.7	41.7
Total	<u>59.7 d/</u>	<u>64.7</u>	<u>124.4</u>

- a. A total of 111 battalions (86 Viet Cong, 25 PAVN) of 500 men each. Each battalion is engaged in combat once in every seven days.
- b. Calculated on the basis of two pounds of food per man per day.
- c. Quartermaster supplies only.
- d. The 17,000 Viet Cong in the local forces require an additional 31.3 tons per day of logistic support from sources within South Vietnam.

Table A-3

Logistical Support for an Expanded Communist Main Force in South Vietnam
Under an Escalated Scale of Combat a/

			Short Tons per Day
<u>Class of Supply</u>	<u>Requirements Supplied from Sources Within South Vietnam</u>	<u>Requirements Supplied from Sources Outside South Vietnam</u>	<u>Total Requirements</u>
Class I (food)	77.5 <u>b/</u>	Negl.	77.5
Class II (quartermaster) and Class IV (weapons)	5.5 <u>c/</u>	35.6	41.1
Class III (POL)	1.9	Negl.	1.9
Class V (ammunition)	Negl.	135.9	135.9
Total	<u>84.9 d/</u>	<u>171.5</u>	<u>256.4</u>

a. A total of 155 battalions (116 Viet Cong, 39 PAVN) of 500 men each. Each battalion is engaged in combat once in every three days.

b. Calculated on the basis of two pounds of food per man per day.

c. Quartermaster supplies only.

d. The 17,000 Viet Cong in the local forces require an additional 48.8 tons per day of logistic support from sources within South Vietnam.

The total requirement for logistic support for the VC/PAVN main force under the present level of fighting is estimated to be about 70 tons per day, with somewhat less than 60 tons required from sources within South Vietnam and about 12 tons, or one-sixth, of the total required from external sources. The internal requirement is made up primarily of food and the external requirement primarily of weapons and ammunition. If the force level remains the same, but the level of fighting escalates to once in seven days, the total logistic requirement increases to about 125 tons per day with about 60 tons required from internal sources and nearly 65 tons or slightly more than one-half of the total from external sources. A buildup of VC/PAVN forces to 155 battalions and an increase in the level of fighting to once in every three days would bring about a substantial increase in dependence on external sources for logistic support. Under these circumstances the total requirement would increase to more than 255 tons per day with about 85 tons required from internal sources and more than 170 tons, or two-thirds of the total, from external sources. Even if the present scale of fighting and the present force do not increase significantly, there are indications that the requirement for external logistic support will increase gradually during 1966 because of the introduction of heavy mortars in main force units and the limited use of PAVN antiaircraft artillery units. Under these circumstances the logistic requirement from external sources for the present force might increase to more than 12 tons per day. The 12 tons per day is based essentially on the experience of 1965, but if the assumptions about ammunition expenditure for heavy weapons change, this figure might double. The following tabulation summarizes the total requirement figures under the various assumptions discussed above:

	<u>Internal Requirement</u>		<u>External Requirement</u>		<u>Total Requirement a/</u>
	<u>Tons per Day</u>	<u>Per-cent</u>	<u>Tons per Day</u>	<u>Per-cent</u>	<u>Tons per Day</u>
111 battalions (current level of combat)	58	83	12	17	70
111 battalions (combat once in seven days)	60	48	65	52	124
155 battalions (combat once in three days)	85	33	171	67	256

a. Because of rounding, components may not agree with the totals shown.

II. Effect of a Denial of Supplies from Sources Within South Vietnam

A complete denial of supplies from sources within South Vietnam is difficult to imagine, but if it were to occur the Communists would essentially be required to ship into the country substantial tonnages of food each day in addition to the large amounts of weapons and ammunition already required. Quartermaster supplies and POL would present few problems because the amounts required would be relatively small. On an annual basis the food required would range from about 20,000 to 28,000 tons, under the three cases considered above. These tonnages are not large in comparison with the annual availability of rice in North Vietnam, amounting to less than 1 percent of the total. Thus it seems feasible to assume that the North Vietnamese could make available the additional food required. Moving the food to South Vietnam on a sustained and predictable basis, however, might be another matter, although the total logistic support required even under the most extensive scale of combat presented above is still within the estimated capacity of the overland supply route through Laos.

25X1

III. Route Capacities*

A. Land

The overland movement of the required tonnages from North Vietnam to the border of South Vietnam is restricted by the capacity of the routes in the Laotian Panhandle rather than by the capacity of the routes in the southern part of North Vietnam. Even route 15, the key route leading to Mu Gia Pass, has an estimated present dry season capacity of 450 tons per day, reduced from 600 tons per day in April 1965 as a result of allied air attacks. The capacity of route 102 leading to the Laos border north of the Demarcation Line is currently 100 tons per day. Over these two roads alone at least 550 tons per day can currently be delivered to the Laotian border.

Present road capacities within Laos are such that 450 tons delivered to Mu Gia Pass can be moved over routes 12, 23, 911, and 9 to Ban Dong where route 92 joins route 9. An additional 100 tons can be delivered to Ban Dong around the end of the Demilitarized Zone from the end of route 102. Thus the Communists can at present deliver 550 tons daily to Ban Dong at the junction of routes 9 and 92. From this point, 400 tons per day can be moved south on route 92 to the junction with route 922, over which 200 tons per day can be moved toward the South Vietnamese border. Before reaching this point, 50 tons per day can be diverted over route 921, also toward the South Vietnamese border. The remaining 150 tons can be moved further south on a segment of route 92, which has a capacity of 150 tons per day, and then over routes 923, 96, and 165 to the border of South Vietnam. Thus the present throughput capacity of the routes in the Laotian Panhandle appears to be about 400 tons per day. However, because of the conservative nature of the joint US/UK methodology used for computing the above road capacities, it is quite possible that more than 400 tons per day can be delivered on a sustained basis to within a few miles of the South Vietnamese border if the Communists make an all-out effort.

It is expected that new access routes from North Vietnam and Laos into South Vietnam will be constructed in 1966. These routes will enhance the infiltration throughput capability by providing a more diverse choice of routes. A new road was observed under construction in late January in a northeasterly direction from route 911. This road may eventually become another border crossing between North Vietnam and Laos south of Mu Gia Pass. Further south, road construction has been under way between Chavane on route 165 and route 16 east of Attopeu. Recent track activity indicates that the work may have been completed, thus providing about 50 miles of motorable road

* For a map showing transportation routes in Cambodia, Laos, and Vietnam, see the map, Figure A-1.

further south on the supply route. Photography of late January and early February also indicated that clearing operations were being conducted at a rapid rate southeast of route 16. If this work continued at the same rate as in early February, a road would have been open to the Cambodian border in the tri-border area (Cambodia, Laos, and South Vietnam) by the last week in February. The improvement of a route into this area is another indication of the increased activity in the Laotian Panhandle in support of Communist supply movements to South Vietnam.

Considering the present and projected level of construction and interdiction in the Panhandle it is estimated that the practical throughput capacity of the Laotian routes will be in the range of 400 to 700 tons at the end of 1966 and that the Communists will be able to sustain a movement of at least 400 tons per day to the end of route 165 or further south to route 16 and beyond if they so desire. On an all-weather basis the Communists are now able to move about 100 tons per day toward the border of South Vietnam -- 50 tons at the end of route 922 and 50 tons at the end of route 165. If it is assumed that 400 tons per day can be moved forward during the 180-day dry season and 100 tons per day during the rainy season, an average of about 250 tons per day can be moved forward on an annual basis.

It should be pointed out that these estimates of road capacity are for sustained movements of at least 90 days duration and that they make no provision for crash movements or various field expedients that the Communists have often employed in the past. For example, when short-term operational moves of 3 or 4 days are considered the road capacity may be doubled or even tripled. In general, it should be kept in mind that estimates of road capacity tend to err on the low side and that all the capacity figures previously cited are at best only very rough approximations of the use which the Communists can make of the cited routes.

Inland waterways have been used to supplement some sections of the road network both in North Vietnam and in Laos. Only one waterway in Laos, the Se Kong River, is known to be used to any extent as part of an infiltration route, although the alignment of other waterways, the Se Bang Hieng, the Se Pone, and the Song Ben Hai, makes them suspect infiltration routes. Aerial photography of the Se Kong between the southern end of route 92 and the point where route 165 leaves the river has revealed waterway improvements, native craft on the river, and portages of difficult sections. This waterway is navigable by canoes throughout the year, but its use during the dry season has probably been reduced since the completion of parallel route 96. The Song Ben Hai/Rao Thanh waterway in the Demilitarized Zone forms the border between North and South Vietnam. Although infiltration of personnel across this river has been reported, infiltration of supplies has not been observed. Use by canoes of this waterway throughout

the year for lateral movement within the Demilitarized Zone to interior tracks, trails, and tributary streams that provide access to South Vietnam is possible, however. Estimates of the capacity of these various waterways are extremely tenuous, ranging generally from 25 to 50 tons per day during the dry season to 50 to 500 tons per day during the rainy season. At best the inland waterways can be used to supplement portions of the road network but cannot be used for through movements.

In general, it may be concluded that the current and projected capacity of the route system through Laos during the dry season is much more than adequate to provide for the amount of tonnage required by Communist main force units in South Vietnam, even if the level of these forces increases by nearly 40 percent and the intensity of combat reaches a scale of more than 10 times its present level.

B. Sea

The capacity of the sea infiltration route from North Vietnam to South Vietnam cannot be quantified with even as much precision as the land route through Laos. Although sea infiltration has provided an important means of supply to the Viet Cong in the past, the sporadic nature of sea movements, the infrequency of detection, and the small number of voyages by any given craft in the course of a year make it very difficult to establish even a theoretical order of magnitude for shipments by sea, let alone the amounts actually moving.

The level of sea infiltration between North and South Vietnam is believed to have been drastically reduced since the inception of the US Market Time operation in 1965. Since that time, no craft identified as infiltrating supplies into South Vietnam by sea have been picked up. Because of the magnitude of the US Market Time operation it is probable that some infiltrating craft would have been intercepted if the North Vietnamese were making a concerted effort to move supplies in this manner. As of November 1965, it was estimated with 95 percent confidence that under the current scope of the Market Time operation only one infiltration craft could escape detection each day and 14 craft each night. If 15 small craft were actually able to get through the blockade during each 24-hour period and each craft carried about 4 tons of supplies each trip, then 60 tons could be delivered on a daily basis. With each craft making one trip a month between North Vietnam and South Vietnam, about 450 craft would be involved. Steel-hulled ships or the larger junks used for infiltration could carry 50 to 100 tons per trip. Even an occasional successful delivery by a ship of this type would add substantially to the amount of material being infiltrated. If the Communists made a determined and concerted effort to infiltrate supplies by sea, however, they would have to be willing to run the risk of experiencing substantial losses.

It can be concluded that the capacity of the sea route in the short term is essentially whatever the Communists want to make it. In the long run, however, this capacity is limited by the number of craft and trained crews available and by the costs the Communists are willing to pay in terms of craft sunk, crews captured or killed, and supplies lost during infiltration attempts. The Market Time operation has increased this potential cost immensely and probably will continue to discourage the Communists from making any serious attempts at large-scale sea infiltration as long as sufficient amounts of supplies can be moved south on the land route through Laos and lesser amounts can be moved along land or sea routes from Cambodia.

C. Cambodia

If the Cambodian government were to permit the use of its territory to support Communist military activities in South Vietnam, the Communists would be able to develop a major and secure supply system into the delta area of South Vietnam. This supply system would have the capacity to move the additional 1,200 tons of military supplies which it is estimated could be handled daily by the port of Sihanoukville. During 1964 this port handled about 800,000 tons, of which more than 200,000 tons were imports. Considering normal port operations only, it is estimated that the port could handle additional imports of at least 450,000 tons per year, or an average of about 1,200 tons per day. This figure could be increased by intensified operation. In addition to the major port of Sihanoukville, Cambodia has three minor ports which are used mostly for fishing and naval activities. A small additional amount of tonnage could be delivered at these ports, but only one of them can accommodate small oceangoing ships. Clearance from Sihanoukville and the minor ports would be mainly by road transport, although coastal water transport using small craft would also be available. A railroad from Sihanoukville to Phnom Penh has been under construction for about five years, but a number of major bridges and most of the tracklaying on the 160-mile route remain to be completed. Cambodia is estimated to have about 10,000 trucks, and more could easily be imported.

The roads leading out of Sihanoukville have a greater capacity than the port itself and could easily handle 1,200 tons per day of military supplies for shipment to South Vietnam. Two roads could be used to clear Sihanoukville: (1) the Sihanoukville-Phnom Penh American Friendship highway and (2) the coastal route direct to South Vietnam. The direct impact of the use of these routes would be almost wholly in the southern part of South Vietnam, particularly in the Mekong Delta region.

The 145-mile Sihanoukville-Phnom Penh American Friendship highway, route 4, with a capacity of 7,000 tons per day in the dry season and 6,300 tons per day in the rainy season, is the major route available to clear the port. From Phnom Penh, supplies could be moved by

either highway or inland waterway to the South Vietnamese border. The best route, however, is highway route 1, which leads to the area facing Tay Ninh Province. Route 1 has a capacity of 3,600 tons per day in the dry season and 1,550 tons per day in the rainy season. The movement of 1,200 tons daily from Sihanoukville to the border on this route would require about 3,000 trucks. There are also two routes that extend north from the Phnom Penh area and connect with route 7, which approaches the northern border of Tay Ninh Province. These routes have lower capacities than route 1, especially in the rainy season, and the distance to the border is greater. From Phnom Penh, two slightly shorter routes extend to the border of Kien Giang and Chau Doc Provinces. At least 1,200 tons per day could be moved over these two routes throughout the year. The coastal road from Sihanoukville has a dry-weather capacity of slightly less than 1,000 tons per day and is the shortest route to the border, only 115 miles. In the rainy season, however, its capacity drops to 130 tons per day.

The major inland waterway is the Mekong River system, which has a capacity to move at least 6,000 tons per day south to the border from Phnom Penh with craft readily available. This capacity could be increased during the high-water season. Supplies could also be moved north to Stung Treng on the Mekong or on parallel route 13 which now is estimated to have a capacity of 3,650 tons per day in the dry season and 1,570 tons per day in the rainy season. From Stung Treng, supplies could be moved on route 19, on trails, or on minor waterways to VC/PAVN forces in Kontum and Pleiku Provinces. At one time, it was believed that this was a difficult route with less capacity than the Lao corridor, but route 19 is now estimated to have a capacity of 700 tons per day in the dry season and 250 tons per day in the rainy season.

The capacities of the various routes mentioned above are expected to remain at approximately the same level at the end of 1966. Although goods could be moved to border crossing points on these routes, the South Vietnamese government has checkpoints at the border crossings of each of the major routes, with the exception of route 1, so supplies would have to be dispersed at some point before the border was reached and moved on local roads, trails, and waterways. The border crossing point on route 1, however, is apparently under Viet Cong control, with the nearest known South Vietnamese military units located about 15 miles to the northeast.

It can be concluded that with sufficient trucks and drivers available, and in the absence of air interdiction, the total volume of supplies which could be cleared through the port of Sihanoukville could be moved forward to the South Vietnamese border over the main routes. In addition, supplies brought in through lesser ports along the Gulf of Siam could be moved by coastal and inland water routes and over trails to the border area.

IV. Options for Resupply

If the land route through the Laotian Panhandle were successfully interdicted, the Communists would be forced to fall back on the sea route and the various routes through Cambodia in order to supply their forces in South Vietnam. Some use might be made of an airlift, although resort to such a procedure would be highly unlikely, considering allied air superiority. However, if even two Il-14's could get through each night to airdrop supplies, they could deliver a total of nearly five tons per day.

The present external logistic requirement of 12 tons per day probably could be satisfied by the use of the sea route, the various routes through Cambodia, and an occasional airdrop. If only one or two small junks per day were able to evade the Market Time blockade, about half the requirement could be fulfilled. The remainder would have to come from or through Cambodia or by air. Through a combined use of normal commercial channels and clandestine means, the Communists could procure and move moderate amounts of supplies through Cambodia. However, it is doubtful that, through clandestine means alone, they could move, on a sustained basis, the entire 12 tons of military supplies needed daily by the VC/PAVN forces in South Vietnam. This doubt arises principally from the fact that illicit traffic of this volume could hardly clear the port of Sihanoukville without detection. If the 12 tons could actually be landed at Sihanoukville or other points along the coast, however, the Communists could undoubtedly move them forward into South Vietnam. At a minimum, the ability of the Communists to move goods clandestinely through Cambodia would be sufficient to provide an important adjunct to infiltration of supplies by sea.

The external logistic requirement of 65 tons per day for the present force fighting once in every seven days would be almost impossible to fulfill without use of the land route through Laos unless the Cambodian government were openly to permit the use of its territory to support Communist military activities in South Vietnam. This is even more obvious in the case of the more than 170-ton logistic requirement for an increased force fighting once in every three days. As pointed out previously, the Communists would have to be prepared to face substantial losses if they attempted to bring in large tonnages by sea on a regular basis. They might succeed in this endeavor for a few weeks, but in the long run the attrition rate would be so high that the costs would probably prove to be prohibitive. Although the capability of the supply system through Cambodia is more than seven times the maximum projection of more than 170 tons of daily external logistic support, this capability could be used only if the Cambodians overtly abandoned their neutralist policies in order to support the Communists. Even if this happened, the capability of VC/PAVN forces to wage war in the central highlands of South Vietnam might be affected measurably by the cutting off of the Panhandle route because the central highlands area is more easily and directly supplied through Laos.

On balance, it does not seem likely that Cambodia will come out openly in support of the Viet Cong. Prince Sihanouk has been particularly sensitive to allegations that the Viet Cong are receiving weapons from Cambodia. Late in 1965, for example, Sihanouk asked the International Control Commission to institute control procedures in the port of Sihanoukville because of press reports concerning possible use of the port by the Communists. Other factors militating against a significant expansion of Communist supply operations through Cambodia include (1) the fact that the Communists would have to get Sihanouk's support to open Cambodian ports, and it is extremely doubtful that he would risk retaliation by such out-and-out cooperation, and (2) the fact that the Communists themselves would hesitate to establish a major supply route which would have to depend on Sihanouk, whom they undoubtedly consider on the basis of past performance to be thoroughly unreliable.

Recent information has indicated increased use of Cambodian territory by the Communists, particularly in the extreme northeast salient of the country. Large numbers of Viet Cong troops have been reported in the Lomphat area, and aerial photographs have shown numerous trails along the border area from the general vicinity of Camp Le Rolland north to route 19, which are believed to indicate Viet Cong activity. PAVN personnel have reportedly infiltrated through this area of Cambodia and some supplies have reportedly been carried from a warehouse on the Cambodian side of the border near route 19 to the Pleiku area in South Vietnam. It has been reported that during a 15-day period nearly 150 short tons were moved to the Viet Cong forces, or about 10 tons per day. This is the largest supply movement that has been reported taking place recently from across the Cambodian border over any sustained period of time, but is it considerably less than the 65 tons per day that would be needed by the present force under an escalated level of combat.

The inescapable conclusion seems to be that the Communists in South Vietnam would be cut off from external logistic support of more than 12 to 20 tons per day if the route through the Laotian Panhandle were blocked, unless Cambodia came out actively and openly in their behalf. It is believed that the latter contingency is unlikely to occur. It should be kept in mind, however, that with only 12 to 20 tons a day flowing in by the sea route and clandestinely through Cambodia, the Communists could maintain their present level of activity, could step up the firepower of their forces, and could even increase their present force by as much as 40 percent, provided the level of fighting remained approximately at its present intensity.

Furthermore, it is highly improbable that complete interdiction of the Panhandle road system could be achieved by air attack alone. Even with so-called successful interdiction, road capacities are probably reduced by no more than two-thirds for short periods of time, and a reduction of one-third over a longer period is about all that can be hoped for. Even where it is impossible to get through traffic moving again in a short period of time, porters can be used to move supplies around interdicted points and for longer hauls if necessary. Even if all road traffic through Laos were brought to a halt, small amounts of supplies could still be infiltrated by use of porters, bicycles, carts, and pack animals, using trails largely invisible from the air.



A-1 Vietnam, Laos, and Cambodia: Transportation

APPENDIX B

THE ROLLING THUNDER ATTACKI. Factors Conditioning the Nature and Scale of Attacks

The US and South Vietnamese air campaign against North Vietnam has been the most restricted and voluntarily limited air war ever conducted by a major air power. It has been used as a carefully controlled means of gradual escalation to achieve strictly limited objectives. Consequently, the program has operated under a set of rigorously defined ground rules.

The Rolling Thunder program over time has extended both the area and the frequency of air attacks in North Vietnam. But self-imposed restrictions have limited both the choice of targets and the areas to be bombed. The existence of large restricted areas has effectively insulated almost 80 percent of North Vietnam's limited modern industrial economy from air attack; these areas contain 75 percent of the nation's population.

The area limitations for armed reconnaissance were confined originally by Rolling Thunder (program number) 7* to an area south of latitude 18 30 N and gradually moved northward, the northernmost extension occurring with Rolling Thunder 30/31 (3-17 September). (See the map, Figure B-1). This line continued until the bombing pause on 24 December 1965. Since the resumption of the attacks with Rolling Thunder 48, the line was pulled back to include the area south of a line running west along latitude 20 31 N to longitude 105 20 E then north to 21 00 N and continuing west to the Laotian border. This line effectively excludes the entire northern part of North Vietnam from armed reconnaissance.

In addition to these area restrictions on armed reconnaissance, attacks on fixed targets were generally held to the southern areas of North Vietnam, moving northward at about the same rate as the armed reconnaissance areas.

Within the general areas demarked by the limits of the armed reconnaissance areas, there are specific sanctuary areas that are exempt from air attacks. These areas include a 30-nautical mile (nm) buffer zone along the Chinese border, a 30-nm radius around the city of Hanoi, and a 10-nm radius around the city of Haiphong.

* For a correlation of the number of a specific Rolling Thunder program with the corresponding date, see Table B-1. For a correlation of the number of a specific week of the Rolling Thunder Program with the corresponding date, see Table B-2.

Attacks on specific fixed targets are limited to those approved in each Rolling Thunder program. These authorizations often provide additional restrictions which limit the number of strikes against approved targets. There is, however, more flexibility in the type of targets for armed reconnaissance. Initially, armed reconnaissance strikes were directed along specific routes against military transport facilities, ferries, radar sites, secondary bridges, and other targets of a military character. Subsequently, the objective was expanded to sustaining day and night interdiction of lines of communication (LOC) for maximum feasible periods through surveillance and destruction of targets of a military character that were encountered, including but not limited to trucks, ferries, lighters, radar sites, secondary bridges, road-repair equipment, and bivouac and staging areas. The objective of the coastal armed reconnaissance strikes was to include destruction of recognized North Vietnamese naval craft and other craft which fired on our aircraft along the North Vietnamese coast, in estuaries and mooring areas, and in the vicinity of coastal islands. For Rolling Thunder 18 (11-17 June) it was stated that daylight armed reconnaissance could include missions to obtain maximum surveillance of LOC's and selected missions with the primary purpose of conducting small precise attacks against pre-briefed military targets with secondary emphasis on the conduct of armed route reconnaissance. Next, Rolling Thunder 22/23 (9-22 July) authorized armed reconnaissance against airfields and JCS-numbered LOC targets which had been assigned in previous Rolling Thunder strikes and which were observed to be under repair.

Other current restrictions in the Rolling Thunder program include the mining of principal ports or attacks on major port facilities. Similar restrictions apply to attacks on major airfields in the northern areas of North Vietnam. There also are specific prohibitions against combat air patrol and screening aircraft attacking these airfields in hot pursuit. Since Rolling Thunder 28/29 (20 August-2 September), strikes against SAM systems within the armed reconnaissance area have been authorized. Until 24 December, SAM's in the Northeast area could be attacked after photographic identification, unless they were in the sanctuary areas. (An exception to the requirement of photographic identification permitted suppression of actual SAM attacks encountered in the course of authorized strikes on fixed targets in the Northeast area.) Since the resumption of bombing in January, strikes on SAM's in the Northeast area have not been authorized. Finally, a policy decision to avoid civilian casualties to the extent possible has resulted in many targets not being attacked.

The overall effect of these area and operational restrictions has been to grant a critical measure of immunity to the military, political, and economic assets used in Hanoi's support of the war in the South. The restrictions also insure a virtually unimpeded flow of military supplies from North Vietnam's allies. The preconditions established for the number of strikes and sorties, the methods of attack, and the avoidance of civilian casualties result in an operational disregard of basic

principles of target selection. Among North Vietnam's target systems, not one has been attacked either intensively or extensively enough to produce a critical reduction in national capacity. No target system can be reduced to its critical point under existing rules.

Finally, the voluntary choice of ground rules which result in an ineffective air campaign may well give the Hanoi regime an unwarranted impression of divided counsel within the US government. The even more limited nature of the US air attacks after the bombing pause may reinforce Hanoi's possible judgment that this restraint reflects a divisiveness and lack of US determination to get on with the war.

Table B-1

Equation of Rolling Thunder Number
with Corresponding Dates

<u>Rolling Thunder Number</u>	<u>Inclusive Dates</u>
1	(Cancelled)
2	(Cancelled)
3	(Cancelled)
4	(Cancelled)
5	2 Mar - 10 Mar
6	11 Mar - 18 Mar
7	19 Mar - 25 Mar
8	26 Mar - 1 Apr
9	2 Apr - 8 Apr
10	9 Apr - 15 Apr
11	16 Apr - 22 Apr
12	23 Apr - 29 Apr
13	30 Apr - 6 May
14	7 May - 13 May
15	18 May - 24 May
16	25 May - 3 Jun
17	4 Jun - 10 Jun
18	11 Jun - 17 Jun
19	18 Jun - 24 Jun
20	25 Jun - 1 Jul
21	2 Jul - 8 Jul
22/23	9 Jul - 22 Jul
24/25	23 Jul - 5 Aug
26/27	6 Aug - 19 Aug
28/29	20 Aug - 2 Sep
30/31	3 Sep - 17 Sep
32/33	18 Sep - 30 Sep
34/35	1 Oct - 14 Oct
36/37	15 Oct - 28 Oct
38/39	29 Oct - 11 Nov
40/41	12 Nov - 25 Nov
42/43	26 Nov - 9 Dec
44/45	10 Dec - 23 Dec
46/47	(Not Used)
48	31 Jan 66 - 28 Feb 66


Table B-2

Equation of Week Number with Corresponding Dates


<u>Week</u>	<u>Inclusive Dates</u>	<u>Week</u>	<u>Inclusive Dates</u>
1	1 Mar - 6 Mar	27	29 Aug - 4 Sep
2	7 Mar - 13 Mar	28	5 Sep - 11 Sep
3	14 Mar - 20 Mar	29	12 Sep - 18 Sep
4	21 Mar - 27 Mar	30	19 Sep - 25 Sep
5	28 Mar - 3 Apr	31	26 Sep - 2 Oct
6	4 Apr - 10 Apr	32	3 Oct - 9 Oct
7	11 Apr - 17 Apr	33	10 Oct - 16 Oct
8	18 Apr - 24 Apr	34	17 Oct - 23 Oct
9	25 Apr - 1 May	35	24 Oct - 30 Oct
10	2 May - 8 May	36	31 Oct - 6 Nov
11	9 May - 15 May	37	7 Nov - 13 Nov
12	16 May - 22 May	38	14 Nov - 20 Nov
13	23 May - 29 May	39	21 Nov - 27 Nov
14	30 May - 5 Jun	40	28 Nov - 4 Dec
15	6 Jun - 12 Jun	41	5 Dec - 11 Dec
16	13 Jun - 19 Jun	42	12 Dec - 18 Dec
17	20 Jun - 26 Jun	43	19 Dec - 25 Dec
18	27 Jun - 3 Jul	44	26 Dec - 1 Jan 1966
19	4 Jul - 10 Jul	45	2 Jan - 8 Jan
20	11 Jul - 17 Jul	46	9 Jan - 15 Jan
21	18 Jul - 24 Jul	47	16 Jan - 22 Jan
22	25 Jul - 31 Jul	48	23 Jan - 29 Jan
23	1 Aug - 7 Aug	49	30 Jan - 5 Feb
24	8 Aug - 14 Aug	50	6 Feb - 12 Feb
25	15 Aug - 21 Aug	51	13 Feb - 19 Feb
26	22 Aug - 28 Aug	52	20 Feb - 26 Feb

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II. Analysis of the Rolling Thunder Operation*

The Rolling Thunder attack reviewed in this Appendix covers two periods. The first period of 43 weeks extended from 2 March through 24 December 1965 and included a 5-day pause (13-17 May) in bombing attacks against North Vietnam. The second period consists of 3 weeks -- 31 January through 19 February 1966. Between them was a 5-week period in which no bombing attacks were made on North Vietnam. An attempt has been made to take note of activity since the resumption of bombing, but the material in this Appendix is concentrated primarily on the 1965 period.**

A. Targets

In the initial weeks of the Rolling Thunder program, US attacks were limited to a primary target or to one of two alternates. If neither the primary target nor an alternate could be struck, ordnance was dumped in the China Sea. Vietnamese Air Force participation prior to or concurrent with US strikes was required, and armed reconnaissance was not authorized. Targets were selected from a list approved by the Joint Chiefs of Staff. This list grew out of a detailed study conducted by the Joint Chiefs in the summer of 1964, when they selected 94 of the most significant targets and routes for armed reconnaissance from among the 470 then known targets in North Vietnam. The target lists were grouped in 5 basic categories -- four fixed target systems plus routes for armed reconnaissance -- and have been continually revised. The tabulation (p. B-8) indicates the status of the fixed target lists as of 8 February 1966. The opportunity for striking fresh fixed targets of importance is extremely limited. Of 233 fixed targets on the current list, 134 have been struck. An additional 8 targets that have been dropped from the current list were also struck prior to being dropped. Of the 99*** targets on the current list that remain unstruck, 69 are inside sanctuary areas, and only 30 are outside. Of these thirty, 20 are in the key northeast area and hence are exempt from armed reconnaissance strikes.

After the beginning of April the attack was expanded to include armed reconnaissance sorties. The Rolling Thunder program defines armed reconnaissance as an air mission flown with the primary purpose of locating and attacking targets of opportunity -- that is, enemy

* Data in this Appendix were derived from individual strike reports given in the Bomb Damage Assessment (BDA) and therefore may not agree with data in other sections and Appendixes which have been derived from other sources such as execute messages and preliminary strike reports. The data, however, have been made as consistent as possible, given problems associated with correction of preliminary data and varied reporting systems.

** For a glossary of terms used in this Appendix, see p. B-32.

*** If mineable approaches to certain ports and naval facilities are considered separate targets, the total of unstruck targets may be regarded as 105, and the total of JCS targets as 239.

System	Targets	Struck	Targets Not Struck		
			Inside Sanctuaries	Outside Sanctuaries	
				Total	In Key NE Area
Airfields (11)	11	4	5	2	2
Lines of communication (74)					
Bridges	61	44 <u>a/</u>	17	2	2
Railroad yards	4	1	2	1	1
Railroad shops	1	0	1	0	0
Locks	8	1	1	6	2
Military installations (125)					
Military barracks/headquarters	57	40	10	7	2
Ammunition depots	17	12	3	2	2
Petroleum storage	13	4	6	3	3
Supply and ordnance depots	18	12	5	1	1
Communication facilities	5	2	3	0	0
Port facilities	6	2	2	2	2
Naval bases	3	2	1	0	0
(Mineable approaches to ports and naval bases)	(6) <u>b/</u>	0	N.A. <u>b/</u>	N.A. <u>b/</u>	N.A. <u>b/</u>
SAM support facilities	1	1	0	0	0
Radar sites	5	10 <u>a/</u>	0	1	0
Industrial installations (23)					
Electric power facilities	17 <u>c/</u>	6	9 <u>c/</u>	2	2
Other	6	1	4	1	1
Total	<u>233</u>	<u>142 a/</u>	<u>69</u>	<u>30</u>	<u>20</u>

a. Including struck targets (2 bridges and 6 radar sites) that have been dropped from the current JCS Fixed Target List.

b. Not applicable. A number of mineable approaches carry the same JCS target numbers as ports and naval facilities but should be regarded as separate targets.

c. Powerplants and 1 transformer substation.

material, personnel, and facilities in assigned areas or along assigned ground communications routes, and not for the purpose of attacking specific briefed targets. Gradually the authorization was expanded to include:

(1) Attacks against small pre-briefed military targets not on the JCS list, followed by armed route reconnaissance.

(2) Restrikes against previously struck JCS-designated fixed targets, excluding locks and dams, located within the armed reconnaissance area, with the objective of keeping them nonoperational.

(3) Attacks against possible SAM systems lying within Rolling Thunder armed reconnaissance areas.

B. Sorties

A total of 42,597 Rolling Thunder sorties were flown against North Vietnam from 2 March 1965 through 19 February 1966 (see Figure B-2). Of this total, 11,064 -- or approximately 26 percent -- were fixed target strike sorties, and 30,832 -- or 72 percent -- were armed reconnaissance strike sorties. The remaining 701 sorties -- 2 percent -- were leaflet drops, photoreconnaissance sorties not accompanying a strike mission, gift drops, and other miscellaneous sorties. The US Navy flew 57 percent of the total sorties, the US Air Force 41 percent, and the South Vietnamese Air Force 2 percent. The weekly distribution of these sorties by type of strike and by service is shown in Table B-3 and in Figures B-3 and B-4.

Excluding the 701 sorties on miscellaneous missions, there were 41,896 combat sorties, which is equal to approximately 9 percent of total combat sorties flown during the entire Korean War from June 1950 through July 1953, and to about 6 percent of total bomber sorties flown by US Army Air Forces against Germany during World War II, 1942-45. Of the combat sorties flown against North Vietnam 26,044, or 62 percent, were strike and flak suppression sorties, and 15,852, or 38 percent, were support sorties. The division by service closely approximated the division of total sorties flown. The US Navy flew 58 percent of the combat sorties, the US Air Force 41 percent, and the South Vietnamese Air Force about 1 percent. Data on total sorties and combat sorties flown from 2 March 1965 through 19 February 1966 are shown by program and service in Figure B-5.

The 11,064 fixed target strike sorties did not represent the total attack on JCS fixed targets. As indicated by Table B-4, 2,948 armed reconnaissance strike sorties participated in the attack on fixed targets. This amounts to approximately 21 percent of a total of 14,012 sorties flown against fixed targets between 2 March 1965 and 19 February 1966. (These armed reconnaissance sorties, however, accounted for only about 8 percent of the total ordnance -- 12,960 tons -- delivered on fixed targets. This reflects, at least in part, the fact that armed reconnaissance sorties attacking fixed targets are on multiple missions and expend part of their ordnance elsewhere.)

During the 43-week period from 2 March through 24 December -- prior to the 5-week cessation of bombing -- a total of 39,641 sorties were flown. Of these 27,932 -- or approximately 70 percent -- were armed reconnaissance strike sorties, 11,064 -- or 28 percent -- were fixed target strike sorties, and the remaining 645 -- or 2 percent -- were leaflet drops, photoreconnaissance missions, and goodwill gift*

* Text continued on p. B-13.

Table B-3

Rolling Thunder: Total Sorties, by Week
2 March 1965 - 19 February 1966

Week	Leaflet and Other	Fixed Target	Armed Recon- naissance	Total Sorties	Service		
					US		South Vietnamese
					Navy	Air Force	Air Force
<u>2 Mar - 24 Dec 65</u>							
1	0	128	0	128	0	108	20
2	0	0	0	0	0	0	0
3	0	342	0	342	195	123	24
4	0	157	0	157	70	47	40
5	0	393	0	393	219	135	39
6	0	471	224	695	456	219	20
7	0	296	150	446	231	200	15
8	0	362	451	813	400	379	34
9	0	165	385	550	305	211	34
10	0	438	262	700	378	292	30
11	198	71	317	586	228	322	36
12	199	356	198	753	400	333	20
13	0	336	434	770	279	463	28
14	0	315	303	618	185	423	10
15	4	302	296	602	288	294	20
16	0	266	341	607	290	287	30
17	0	409	291	700	390	282	28
18	2	334	329	665	398	237	30
19	4	261	393	658	416	226	16
20	6	284	361	651	402	229	20
21	24	415	347	786	443	329	14
22	6	461	473	940	586	321	33
23	0	488	747	1,235	826	397	12
24	24	346	902	1,272	960	306	6
25	0	323	905	1,228	856	362	10
26	0	208	1,097	1,305	737	556	12
27	0	24	1,020	1,044	625	419	0
28	0	495	1,340	1,835	1,026	798	11
29	0	478	1,021	1,499	675	824	0
30	13	346	1,118	1,477	735	732	10
31	15	122	1,063	1,200	782	418	0
32	16	263	1,684	1,963	1,276	679	8
33	17	0	992	1,009	718	291	0
34	20	150	1,079	1,249	732	517	0
35	20	78	1,138	1,236	795	441	0
36	5	129	1,317	1,451	997	454	0
37	10	107	1,276	1,393	885	508	0
38	10	214	1,127	1,351	935	409	7
39	6	161	1,061	1,228	572	656	0

Table B-3

Rolling Thunder: Total Sorties, by Week
 2 March 1965 - 19 February 1966
 (Continued)

Week	Leaflet and Other	Fixed Target	Armed Recon- naissance	Total Sorties	Service		
					US		South Vietnamese
					Navy	Air Force	Air Force
<u>2 Mar - 24 Dec 65</u>							
40	22	194	1,044	1,260	643	606	11
41	14	0	917	931	477	445	9
42	8	63	817	888	410	478	0
43	2	313	712	1,027	464	554	9
Total: 2 Mar - 24 Dec 65	<u>645</u>	<u>11,064</u>	<u>27,932</u>	<u>39,641</u>	<u>22,685</u>	<u>16,310</u>	<u>646</u>
Cessation of Bomb- ing, Weeks 44-48, 25 Dec 65 - 30 Jan 66							
<u>31 Jan - 19 Feb 66</u>							
49	28	0	731	759	312	447	0
50	28	0	1,231	1,259	771	488	0
51	0	0	938	938	563	375	0
Total: 31 Jan - 19 Feb 66	<u>56</u>	<u>0</u>	<u>2,900</u>	<u>2,956</u>	<u>1,646</u>	<u>1,310</u>	<u>0</u>
Total Rolling Thunder 2 Mar 65 - 19 Feb 66	<u>701</u>	<u>11,064</u>	<u>30,832</u>	<u>42,597</u>	<u>24,331</u>	<u>17,620</u>	<u>646</u>

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Program	Sorties Flown			Percent Through		Ordnance Delivered		
	Strike and Flak Suppression	Support	Number	Percent Through		Tons	Percent Through	
				24 Dec 65	19 Feb 66		24 Dec 65	19 Feb 66
Fixed target								
2 Mar - 24 Dec 65	6,928	4,136	11,064	80	79	11,960	93	92
Armed reconnaissance a/								
2 Mar - 24 Dec 65	1,778	1,046	2,824	20	20	840	7	7
Total 2 Mar - 24 Dec 65 a/	<u>8,706</u>	<u>5,182</u>	<u>13,888</u>	<u>100</u>		<u>12,800</u>	<u>100</u>	
Armed reconnaissance a/								
31 Jan - 19 Feb 66	<u>113</u>	<u>11</u>	<u>124</u>		<u>1</u>	<u>160</u>		<u>1</u>
Total armed reconnaissance through 19 Feb 66 a/	1,891	1,057	2,948		21	1,000		8
Total 2 Mar 65 - 19 Feb 66 a/	<u>8,819</u>	<u>5,193</u>	<u>14,012</u>		<u>100</u>	<u>12,960</u>		<u>100</u>

a. Including aircraft that were on multiple strike missions, in some cases striking more than one fixed target.

Attack on JCS Fixed Targets
2 March 1965 - 19 February 1966

Table B-4

drops. Approximately 57 percent of the sorties were flown by the US Navy, 41 percent by the US Air Force, and 2 percent by the South Vietnamese Air Force. Data on sorties flown during the period 2 March - 24 December 1965 are summarized and distributed according to program, strike mission, and service in Figure B-6.

In the three weeks from 31 January through 19 February 1966 -- the period after resumption of bombing North Vietnam -- no fixed target strike sorties were flown. Out of a total of 2,956 sorties flown during the period, 56 were leaflet drops and 2,900 were armed reconnaissance sorties. Of the latter number, 124 were restrikes on 15 JCS fixed targets as follows:

Barracks	6
Bridges	3
Ammunition depots	2
Airfields	2
Port facilities	1
Railroad yards	1
Total	<u>15</u>

Sorties during this period are depicted graphically in Figure B-7.

C. Ordnance

During the period from 2 March 1965 to 19 February 1966, Rolling Thunder sorties delivered a total of 37,000 tons of ordnance on targets in North Vietnam.* This is equal to approximately 8 percent of total ordnance expended in air operations in the Korean War and to about 3 percent of the tons of bombs dropped by US Army Air Forces on Germany in World War II. When total ordnance delivered is related to total combat sorties, an average of nearly 0.9 ton per sortie is

* In this Appendix, ordnance is measured in short tons (2,000 pounds). All estimates of "ordnance delivered" are based on launch weights. As such, however, they must be regarded as minimum estimates, because of the methodology used in their compilation. They were compiled from data in BDA reports of individual strikes. Where type designations were not specific, for example "2 Bullpups," the smallest applicable type was consistently assumed. In this example the AGM-12 B, 250-pound Bullpup (launch weight: 567 pounds) was assumed, rather than the AGM-12 C, 1,000-pound Bullpup (launch weight: 1,778 pounds). Also, where types were indicated, but numbers were absent, for example "Napalm" or "Zuni," only one bomb of the smallest applicable type was assumed, although it is probable that more than one was dropped. Also no weights were included for such reports as "Fammo."

indicated. This is approximately the same average load per sortie as that indicated by the data for total ordnance expended and total combat sorties flown during the Korean War. The ratio of tons of bombs dropped to total bomber and fighter sorties flown by US Air Forces against Germany in World War II was more than 0.8 ton per sortie. When ordnance delivered in North Vietnam is related to total strike plus flak suppression sorties an average load of 1.4 tons per sortie is obtained, compared with an average load of 1.9 tons per bomber sortie flown by US Air Forces against Germany in World War II.

Of the 37,000 tons of ordnance expended on North Vietnam, the US Air Force delivered 62 percent, the US Navy 35 percent, and the South Vietnamese Air Force 3 percent (see Table B-5 and Figure B-8). Approximately 11,960 tons -- or 32 percent -- of the total were delivered on fixed target strikes, and more than 25,000 tons -- or 68 percent -- were delivered on armed reconnaissance. The latter figure includes about 1,000 tons (3 percent of the total) delivered on fixed targets by armed reconnaissance sorties. The weekly expenditure of ordnance is allocated to the fixed target and armed reconnaissance programs in Table B-6 and Figure B-9.

During the period 2 March-24 December a total of 34,300 tons of ordnance were expended on targets in North Vietnam. Of this amount, 11,960 tons -- or 35 percent -- were delivered by fixed target strike sorties and an additional 840 tons -- or 2 percent -- were delivered on fixed targets by armed reconnaissance strike sorties. Thus 37 percent of the total ordnance delivered during 1965 was on fixed targets. (The allocation of ordnance delivered during this period is indicated, by service and by attack program, in Figure B-10.)

In 1966, after the resumption of bombing, approximately 2,700 tons of ordnance were delivered during the period from 31 January through 19 February. As in 1965 the US Air Force delivered about 62 percent of the total. The share of the US Navy, which was 35 percent during 1965, increased to 38 percent during the 1966 period. The South Vietnamese Air Force, which delivered 3 percent of the ordnance in 1965, delivered none in the first three weeks after resumption of bombing in 1966. As indicated previously, there were no fixed target strike sorties during this period, but armed reconnaissance sorties delivered approximately 1,000 tons of ordnance on restrikes of JCS fixed targets. During the week of 6-12 February (the 50th week of the Rolling Thunder program) armed reconnaissance strike sorties delivered 120 tons of ordnance on fixed targets, the largest amount delivered on fixed targets by armed reconnaissance sorties during any single week of the Rolling Thunder program (see Table B-6 and Figure B-9).*

* Text continued on p. B-19.

Table B-5

Rolling Thunder: Ordnance Expended, by Week and by Service
2 March 1965 - 19 February 1966

Week	Service			Tons ^a / _*
	US		South Vietnamese	Total
	Navy	Air Force	Air Force	
<u>2 Mar - 24 Dec 65</u>				
1	0	160	40	200
2	0	0	0	0
3	120	260	80	460
4	60	30	110	200
5	150	210	80	440
6	350	290	50	690
7	150	200	30	380
8	150	420	60	630
9	110	230	40	380
10	110	400	30	540
11	60	90	40	190
12	220	60	10	300 ^b / _/
13	150	410	50	610
14	90	440	20	550
15	290	380	40	710
16	190	660	50	900
17	420	520	50	990
18	270	380	50	700
19	380	360	30	770
20	340	310	10	660
21	400	430	20	850
22	370	430	50	840 ^b / _/
23	460	660	20	1,140
24	370	470	0	840
25	390	600	20	1,010
26	400	880	20	1,300
27	340	320	0	660
28	490	1,160	20	1,670
29	330	1,130	0	1,470 ^b / _/
30	470	1,080	20	1,570
31	370	430	0	800
32	480	1,000	10	1,490
33	280	500	0	780
34	340	860	0	1,200
35	280	840	0	1,120
36	460	700	0	1,160
37	400	850	0	1,250
38	370	480	20	870
39	400	740	0	1,140
40	260	550	10	820

* Footnotes follow on p. B-16.

25X1

Table B-5

Rolling Thunder: Ordnance Expended, by Week and by Service
 2 March 1965 - 19 February 1966
 (Continued)

				Tons ^{a/}
Week	Service			Total
	US		South Vietnamese	
	Navy	Air Force	Air Force	
<u>2 Mar - 24 Dec 65</u>				
41	230	430	0	660
42	210	270	0	480
43	240	640	Negl.	880
Total: 2 Mar - 24 Dec 65	<u>11,950</u>	<u>21,260</u>	<u>1,080</u>	<u>34,300 b/</u>
Cessation of Bomb- ing, Weeks 44-48, 25 Dec 65 - 30 Jan 66				
<u>31 Jan - 19 Feb 66</u>				
49	260	510	0	770
50	400	700	0	1,100
51	360	480	0	840
Total: 31 Jan - 19 Feb 66	<u>1,020</u>	<u>1,690</u>	<u>0</u>	<u>2,710</u>
Total Rolling Thunder 2 Mar 65 - 19 Feb 66	<u>12,970</u>	<u>22,950</u>	<u>1,080</u>	<u>37,000 b/</u>

a. Rounded to nearest 10 tons except for grand total and total for 1965, which are to the nearest 100 tons. Deliveries of less than 5 tons are indicated as Negligible (Negl.).

b. Because of rounding, totals may not agree with the components shown.

25X1

Table B-6

Rolling Thunder: Ordnance Expended, by Week and by Program
2 March 1965 - 19 February 1966

Week	On Fixed Targets		On Armed Reconnaissance			Tons ^{a/}
	(1)	(2)	(3)	(4)	(5)	(6)
	Total On Fixed Targets (Col 2+3)	By Fixed Target Strikes	By Armed Reconnaissance Strikes	Armed Reconnaissance Not On Fixed Targets	Total On Armed Reconnaissance (Col 3+4)	Total (Col 1+4)
<u>2 Mar - 24 Dec 65</u>						
1	200	200	0	0	0	200
2	0	0	0	0	0	0
3	460	460	0	0	0	460
4	200	200	0	0	0	200
5	440	440	0	0	0	440
6	630	630	0	60	60	690
7	350	310	40	30	70	380
8	450	360	90	180	270	630
9	220	140	80	160	240	380
10	460	460	0	90	90	540
11	90	90	0	90	90	190
12	240	240	0	60	60	300
13	470	470	0	140	140	610
14	410	410	0	140	140	550
15	410	410	0	300	300	710
16	420	420	0	480	480	900
17	640	640	0	350	360	990
18	390	390	Negl.	310	300	700
19	200	200	0	570	570	770
20	360	280	80	300	380	660
21	380	380	Negl.	470	470	850
22	350	350	0	490	490	840
23	410	360	50	730	780	1,140
24	320	290	30	520	550	840
25	370	260	110	640	750	1,010
26	320	320	0	980	980	1,300
27	50	50	0	610	610	660
28	550	550	0	1,120	1,120	1,670
29	630	630	0	840	840	1,470
30	440	440	Negl.	1,130	1,130	1,570
31	170	160	10	630	640	800
32	240	230	10	1,250	1,260	1,490
33	10	0	10	770	780	780
34	180	150	30	1,020	1,050	1,200
35	220	170	50	900	950	1,120
36	140	70	70	1,020	1,090	1,160
37	150	140	10	1,100	1,110	1,250
38	200	170	30	670	700	870
39	140	130	10	1,000	1,010	1,140
40	160	130	30	660	690	820
41	30	0	30	630	660	660
42	60	20	40	420	460	480
43	240	210	30	640	670	880
Total 2 Mar - 24 Dec 65	<u>12,800</u>	<u>11,960</u>	<u>840</u>	<u>21,500</u>	<u>22,340</u>	<u>34,300</u>

Cessation of Bombing,
Weeks 44-48,
25 Dec 65-30 Jan 66

Table B-6

Rolling Thunder: Ordnance Expended, by Week and by Program
 2 March 1965 - 19 February 1966
 (Continued)

						Tons ^{a/}
Week	On Fixed Targets			On Armed Reconnaissance		(6)
	(1)	(2)	(3)	(4)	(5)	
	Total On Fixed Targets (Col 2+3)	By Fixed Target Strikes	By Armed Reconnaissance Strikes	Armed Reconnaissance Not On Fixed Targets	Total On Armed Reconnaissance (Col 3+4)	
<u>31 Jan - 19 Feb 66</u>						
49	0	0	Negl.	770	770	770
50	120	0	120	980	1,100	1,100
51	40	0	40	800	840	840
Total 31 Jan - 19 Feb 66	<u>160</u>	<u>0</u>	<u>160</u>	<u>2,550</u>	<u>2,710</u>	<u>2,710</u>
Total Rolling Thunder 2 Mar 65 - 19 Feb 66	<u>12,960</u>	<u>11,960</u>	<u>1,000</u>	<u>24,050</u>	<u>25,050</u>	<u>37,000</u>

a. Rounded to nearest 10 tons except for grand total and total for 1965, which are to the nearest 100 tons. Because of rounding, totals may not agree with the components shown. Deliveries of less than 5 tons are indicated as Negligible (Negl.).

D. Consistency of Attack and Delivery Capabilities

When either the data for sorties or ordnance are plotted by week, considerable unevenness in the attack on North Vietnamese targets becomes immediately apparent (see Figures B-3 and B-4 for sorties and B-8 and B-9 for ordnance). A hypothesis that weather might be the cause of the variation in intensity of attack was tested by adding to "sorties flown" the sorties that were canceled because of weather. Unfortunately, data on cancellations were available only for the period from 1 October through 24 December (see Table B-7). Even this somewhat inadequate sample, however, indicates that weather is not the cause of the apparent irregularity of attack. Adding the sorties canceled merely moved the fluctuations to a higher level but did not tend to eliminate them (see Figure B-4).

When the data for sorties and tons of ordnance delivered were grouped by months, the unevenness noted in the weekly data disappeared (see Tables B-8 and B-9). This becomes most apparent in the graphic presentation of the monthly data in Figures B-11 through B-14. The curves for sorties smoothed, built up gradually (with the exception of a slight dip in June*) to a peak in September and October, and thereafter fell off slightly in November and more sharply in December. When monthly sorties flown in North Vietnam were compared with monthly sorties flown in South Vietnam and Laos, sorties in other areas were found to increase at times when the number of sorties against North Vietnam declined (see Figure B-15). In June, sorties against targets in North Vietnam and Laos declined, but there was a nearly offsetting increase in sorties against targets in South Vietnam. In October, and to an even greater degree in November, there was a decline in the number of sorties against targets in North Vietnam, yet there was a more than offsetting increase in the number of sorties against targets in South Vietnam and Laos, so that the number of sorties for the combined area of North Vietnam, South Vietnam, and Laos showed substantial increase. In December, sorties against North Vietnam were flown only through $3\frac{1}{2}$ weeks. Had sorties been flown in the last week of December equal to the weekly average of the first $3\frac{1}{2}$ weeks, total sorties flown against North Vietnam would have been about the same in December as in November. The number of sorties against South Vietnam in December was somewhat greater than in November but was in keeping with the trend of previous months. The number of sorties flown against targets in Laos**

* A decrease in ordnance delivered is evident in May (see Figures B-13 and B-14), a month when the total number of sorties increased (see Figures B-11 and B-12). This is because airstrikes against North Vietnamese targets were suspended for political purposes for a 5-day period 13-17 May, but 397 photoreconnaissance missions were flown during the same period. The effect of these photoreconnaissance missions on total sorties flown is evident in the plotting of the data for May in Figure B-12 and even more evident in the plotting of data for the 11th and 12th weeks of the Rolling Thunder program in Figure B-3.

** Text continued on p. B-23.

Table B-7

Rolling Thunder: Cancellations Because of Weather
1 October - 24 December 1965

<u>Dates</u>	<u>Week</u>	<u>Number of Sorties</u>
October		
1 - 7	31/32	135
8 - 14	32/33	76
15 - 21	33/34	288
22 - 28	34/35	285
November		
29 - 4	35/36	191
5 - 11	36/37	42
12 - 18	37/38	201
19 - 25	38/39	205
December		
26 - 2	39/40	316
3 - 9	40/41	566
10 - 16	41/42	483
17 - 23	42/43	662
24	43	31
Total		<u>3,481</u>

Table B-8

Rolling Thunder: Total Sorties, by Month
March-December 1965

25X1

Month	Program				Service		
	Leaflet and Other	Fixed Target	Armed Recon- naissance	Total Sorties	US		South Vietnamese Air Force
					Navy	Air Force	
Mar	0	850	0	850	382	345	123
Apr	0	1,464	1,200	2,664	1,484	1,077	103
May	397	1,301	1,237	2,935	1,295	1,516	124
Jun	4	1,361	1,386	2,751	1,378	1,265	108
Jul	42	1,586	1,732	3,360	2,020	1,257	83
Aug	24	1,389	4,221	5,634	3,743	1,851	40
Sep	28	1,441	4,594	6,063	3,202	2,840	21
Oct	73	570	5,458	6,101	3,943	2,150	8
Nov	47	574	5,108	5,729	3,582	2,140	7
Dec	30	528	2,996	3,554	1,656	1,869	29
Total	645	11,064	27,932	39,641	22,685	16,310	646

Table B-9

Rolling Thunder: Ordnance Expended, by Month, by Program, and by Service
March-December 1965

25X1 Tons						
Month	Program		Total	Service		
	Armed Recon- naissance ^{a/}	Fixed Target		US		South Vietnamese Air Force
				Navy	Air Force	
Mar	0	1,130	1,130	280	540	310
Apr	640	1,620	2,260	800	1,280	180
May	380	1,420	1,800	540	1,100	160
Jun	1,430	1,900	3,330	1,150	1,990	190
Jul	2,060	1,410	3,470	1,590	1,780	100
Aug	3,390	1,280	4,670	1,830	2,780	60
Sep	3,740	1,780	5,520	1,700	3,790	30
Oct	4,500	590	5,090	1,560	3,520	10
Nov	4,040	480	4,520	1,690	2,810	20
Dec	2,160	350	2,510	810	1,680	20
Total	<u>22,340</u>	<u>11,960</u>	<u>34,300</u>	<u>11,950</u>	<u>21,270</u>	<u>1,080</u>

a. Including 840 tons of ordnance expended by armed reconnaissance strike sorties on fixed targets.

increased markedly -- to an even greater degree than sorties against North Vietnam declined. Thus the data clearly reflect a decision to use in Laos those aircraft not used against North Vietnam in the last week of December. This analysis strongly suggests that the fluctuations noted in the weekly data were occasioned by necessity for temporarily shifting aircraft from attack on North Vietnam to support ground operations in South Vietnam or to attack targets in Laos.*

Thus it becomes clear that the capability of the US and South Vietnamese Air Forces for delivering ordnance on targets in North Vietnam cannot be defined in isolation. Forces available in Southeast Asia can be used, as necessity or policy dictates, in varying combinations and degree against the three principal target areas of South Vietnam, North Vietnam, and Laos. Prior to the cessation of bombing in North Vietnam in late December, the priority on sorties flown against targets in the three areas was: 1st priority, South Vietnam; 2nd priority, North Vietnam; and 3rd priority, Laos. The relative effort expended in the three areas is reflected in the following percentages of cumulative attack sorties flown against targets in South Vietnam, North Vietnam, and Laos during July-December 1965:

<u>Target Area</u>	<u>Percent</u>
South Vietnam	72
North Vietnam	20
Laos	8

The current delivery capability of forces now available in Southeast Asia is reflected in the 18,335 attack sorties flown during the

* A desirable test of the hypothesis that decreases in the intensity of attack on North Vietnam have coincided with increased air activity in other areas would be comparison of weekly data for each of the three areas concerned. Unfortunately, weekly data for sorties against targets in Laos and South Vietnam were not readily available, and the time available for preparation of this Appendix did not permit further investigation of this topic.

month of December 1965.* These attack sorties are allocated by service in the following tabulation:

Air Force	8,436
Navy	5,207
Marines	2,103
Vietnamese Air Force	2,589
Total	<u>18,335</u>

Allowing for the fact that the period covered by the 18,335 sorties included a cessation of air operations in North Vietnam from 1800 hours on 24 December through 31 December and in South Vietnam a 30-hour cessation over Christmas, an approximate capability of 630 sorties per day is indicated. A peak effort for a limited period of time could substantially increase this daily sortie rate, but the above data are indicative of a normal month-to-month capability. If the average load of 1.4 tons of ordnance per sortie observed for strike plus flak suppression sorties against North Vietnam is assumed for the 630 sorties per day, there exists in the Southeast Asian area a current capability for delivering more than 26,000 tons of ordnance per month. Allocation of 20 percent of this amount to attacks on targets in North Vietnam would result in delivery of slightly more than 5,000 tons per

* The attack sorties flown against targets in the three primary areas during December 1965 were distributed according to service and type of aircraft as follows:

Type of Aircraft	Service			Vietnamese Air Force	Total	
	Air Force	Navy	Marines		Number of Sorties	Percent
B-52	316				316	1.7
B-57	521				521	2.8
A-1	1,560	475		2,589	4,624	25.3
A-3		11			11	0.1
A-4		3,242	1,201		4,443	24.3
A-6		120			120	0.7
F-4	1,377	931	836		3,144	17.1
F-5	643				643	3.5
F-8		428	66		494	2.7
F-100	2,117				2,117	11.5
F-102	76				76	0.4
F-105	1,781				1,781	9.7
FC-47	45				45	0.2
Total	<u>8,436</u>	<u>5,207</u>	<u>2,103</u>	<u>2,589</u>	<u>18,335</u>	<u>100</u>

month -- an amount which approximates the average monthly delivery during the four-month period August-November and is somewhat below the amount delivered in the peak month of September (see Table B-9 and Figure B-13).

E. Increasing Share of Armed Reconnaissance in Total Effort

Next to the unevenness noted when weekly data for sorties and ordnance were plotted in Figures B-3 and B-9, the most evident fact was the steady increase in armed reconnaissance as a share of the total air attack on North Vietnam. The monthly summaries plotted in Figures B-11 through B-14 reveal even more clearly the relative shares of the various services and of the fixed target and armed reconnaissance programs in the total effort. The dramatic increase in the share of armed reconnaissance (see Figures B-12 and B-14) undoubtedly reflects the diminishing number of new fixed targets available for attack, broadened authorization for armed reconnaissance, and at least in part a change in definitions used in bookkeeping. As the number of categories of permissible armed reconnaissance targets has increased and, as re-strikes on fixed targets have come to be permitted on armed reconnaissance missions, some sorties have been classified as armed reconnaissance that previously would have been classified as strikes on fixed targets.

F. Relative Shares of Services in the Air Attack

The monthly data plotted for the period March-December 1965 clearly reveal that the US Navy has flown the largest number of sorties (Figure B-11) and that the US Air Force has delivered the largest share of the ordnance (Figure B-13). This fact is also evident from the data pertaining to the entire period from 2 March 1965 through 19 February 1966 (see Table B-10).

Table B-10

Share of Services in Total Sorties and Total Ordnance Delivered
2 March 1965 - 19 February 1966

<u>Service</u>	<u>Percent of Total Sorties</u>	<u>Percent of Total Ordnance Delivered</u>
US Navy	57	35
US Air Force	41	62
Vietnamese Air Force	2	3
Total	<u>100</u>	<u>100</u>

That the US Air Force delivered 62 percent of the ordnance but flew only 41 percent of the sorties highlights the fact that the average load of aircraft flown by the Air Force is greater than that of the Navy aircraft. During 1965 the average load of strike plus flak suppression sorties flown by the Air Force against targets in North Vietnam was slightly more than twice the average load of such sorties flown by the Navy. Consequently, the Navy must fly more sorties to deliver a given quantity of ordnance. This frequency of exposure was at first regarded as a significant fact in considering losses of aircraft.

G. Losses

During the period from 2 March 1965 through February 1966 a total of 181 aircraft and 154 men were lost on Rolling Thunder missions. (An additional 65 men were lost but recovered.) Losses by service are indicated in the following tabulation:

<u>Service</u>	<u>Aircraft</u>	<u>Personnel</u>	
		<u>Lost</u>	<u>Recovered</u>
US Navy	95	85	33
US Air Force	78	63	30
South Vietnamese Air Force	8	6	2
Total	<u>181</u>	<u>154</u>	<u>65</u>

The fact that the Navy suffered the largest number of losses seemed to bear out the hypothesis that there is a close connection between losses and frequency of exposure. Further investigation, however, revealed that Navy losses represent a smaller percentage of sorties flown than do Air Force losses (see Table B-11). It was concluded that differences in the types of missions flown were offsetting the influence of frequency of risk. During the period 2 March - 24 December 1965, roughly the same number of sorties against fixed targets were flown by both services -- 5,554 by the Navy and 5,050 by the Air Force. The Navy, however, flew about 1.6 times the number of armed reconnaissance sorties flown by the Air Force -- 16,932 by the Navy and 10,831 by the Air Force. Approximately 75 percent of the total number of sorties flown by the Navy were on armed reconnaissance, whereas only 66 percent of total sorties flown by the Air Force were on armed reconnaissance.* This difference becomes significant when aircraft losses are examined by type of mission.

* Details concerning armed reconnaissance and fixed strike sorties are available in the files of this Office.

Table B-11

Rolling Thunder: Relationship Between Aircraft Losses
and Total Sorties Flown
2 March 1965 - 19 February 1966

<u>Service</u>	<u>Total Sorties Flown</u>	<u>Aircraft Losses</u>	<u>Losses as a Percent of Sorties Flown</u>
US Navy	24,331	95	0.39
US Air Force	17,620	78	0.44
South Vietnamese Air Force	646	8	1.2
Total	<u>42,597</u>	<u>181</u>	0.4

Of the total number of aircraft lost from 2 March 1965 through 19 February 1966, 106 were on armed reconnaissance missions, 74 were on sorties against fixed targets, and 1 was on a photoreconnaissance mission. However, an average of 7 aircraft were lost per 1,000 sorties against fixed targets, not including SAM sites, but the comparable figure for armed reconnaissance was only 3 aircraft per 1,000 sorties. (This lower loss ratio for armed reconnaissance sorties, coupled with the high percentage of total Navy sorties that are on armed reconnaissance, tends to explain why Navy losses amount to a smaller percentage of sorties flown than do Air Force losses.) From 2 March 1965 through 19 February 1966, losses of aircraft by type of task were 131 on strike missions, 11 on flak suppression missions, and 39 on other missions. This is a loss-to-sortie ratio of 0.5 percent for strike plus flak suppression sorties and of 0.2 percent for support sorties. Ground fire is the most frequently reported cause of aircraft loss. Only 12 losses were reported as being caused by SAM's.

During the period from 2 March 1965 through 19 February 1966 losses per 100 sorties against various target systems were as indicated by the following tabulation:

<u>Target System</u>	<u>Losses per 100 Sorties</u>	<u>Target System</u>	<u>Losses per 100 Sorties</u>
SAM sites	2.03	Powerplants	0.81
Railroad yards	1.80	Ports	0.46
Radar sites	1.59	Petroleum storage	0.41
Explosives plants	1.28	Supply depots	0.40
Naval bases	1.14	Ammunition depots	0.30
Bridges	0.89	Barracks	0.21

With the exception of the categories "Railroad Yards" and "Explosives Plants" -- which probably are not representative samples, because only one target of each category was struck -- the above tabulation probably is indicative of the relative intensity of defenses at the various types of targets.

Losses by type of aircraft are indicated in the following tabulation of data for the 1965 period. Losses ranged from 0.3 to 0.7 percent of sorties flown by the types of aircraft that flew the largest shares of total sorties. Several types of aircraft that flew fewer missions incurred higher proportional losses. For example, the data on the A-1E undoubtedly reflect both the small number of sorties flown and unfortunate chance circumstances.

<u>Type of Aircraft Lost</u>	<u>Number of Aircraft Lost</u>	<u>Sorties Flown by This Type of Aircraft as a Percent of Total Sorties Flown by All Types of Aircraft</u>	<u>Losses as a Percent of Total Sorties Flown by This Type of Aircraft</u>
F-105	54	23	0.6
A-1H	24	8.8	0.7
A-4E	15	12.2	0.3
A-4C	14	7.1	0.5
F-4C	10	9.3	0.3
F-4B	9	5.7	0.4
F-8D	8	1.8	1.1
F-8E	7	5.9	0.3
RF-101	6	0.7	2.1
RF-8A	6	0.9	1.7
F-100	5	1.0	1.2
RA-5C	3	0.3	2.3
A-6A	3	1.2	0.6
A-1E	2	0.01	50
EA-1F	1	1.8	0.1
B-57	1	0.4	0.7
Helicopters	3	Not included	N.A.

H. Costs

The total cost of the Rolling Thunder attack on targets in North Vietnam during the period from 2 March 1965 through 19 February 1966 is estimated at about \$470 million. As indicated in Figure B-2, this figure represents approximately \$330 million in aircraft losses, \$80 million in the operational cost of sorties flown, and \$60 million in the cost of ordnance expended.

During the period 2 March-24 December 1965 the program cost approximately \$440 million. The cost of damage to the economy of North Vietnam during the same period has been estimated at about \$63 million (see Table B-12 and Figure B-16). The value of the attack on targets in North Vietnam obviously must be measured in military, political, and psychological terms rather than economic. It must be noted, moreover, that a large share of the cost of the Rolling Thunder program is incurred in connection with armed reconnaissance strikes that frequently result in damage to targets having a lower restoration cost than that of most fixed targets. The cost of the armed reconnaissance program during 2 March - 24 December 1965 is estimated at approximately 63 percent of the total \$440 million cost of Rolling Thunder. In contrast, only 21 percent of the estimated cost of damage to the economy of North Vietnam is attributed to the armed reconnaissance program.

Table B-12

Estimated Costs of Rolling Thunder
Related to Costs of Damage to the Economy of North Vietnam
2 March-24 December 1965

Million US \$					
Month	Sortie Overhead <u>a/</u>	Aircraft Losses <u>b/</u>	Ordnance <u>c/</u>	Total	Cost to North Vietnam <u>d/</u>
March	1.5	18.8	1.7	22.0	1.3
April	4.8	23.3	3.6	31.7	3.2
May	4.6	14.6	3.9	23.1	4.4
June	4.8	18.8	5.7	29.3	8.9
July	5.9	45.0	5.1	56.0	10.0
August	10.1	34.5	8.6	53.2	10.0
September	11.0	39.0	10.6	60.6	8.0
October	11.4	39.4	5.8	56.6	5.3
November	11.8	27.2	7.4	46.4	5.3
December	7.5	45.2	3.8	56.5	6.9
Total	<u>73.4</u>	<u>305.8</u>	<u>56.2</u>	<u>435.4</u>	<u>63.3</u>

a. Based on average operating costs per sortie for different types of aircraft as indicated by data contained in US Army, STAG, Assessment of the Air Effort in Vietnam and Laos, Annex A, Appendix II, Tab B, Appendix III, Tab B, and Appendix IV, Tab B, TOP SECRET. These data on average cost per sortie were applied to the sum of data on sorties contained in the BDA.

b. Average costs of production models of various types of aircraft taken from US Army, STAG, were applied to data on aircraft losses contained in the BDA.

c. Average costs of various types of ordnance taken from US Army, STAG, were applied to data on ordnance expended contained in the BDA.

d. Including restoration costs for damage in installations and equipment and losses incurred in agriculture and export.

Estimated total monthly costs of the Rolling Thunder program during March-December 1965 are compared with the estimated monthly cost of damage to the economy of North Vietnam in Figure B-17 and Table B-13. The pattern of the two monthly series is roughly similar; however, there is a wide gap between the two. The costs of the program exceed the value of damage to the North Vietnamese economy by \$20 million to \$50 million per month. It is evident that there is a direct relationship between damage caused and the scale of effort, but the cost is high.

Table B-13

Monthly Cost of Rolling Thunder
Compared with Cost of Damage to Economy of North Vietnam
2 March-24 December 1965

Million US \$			
<u>Month</u>	<u>Cost of Rolling Thunder</u>	<u>Cost to North Vietnam</u>	<u>Difference</u>
March	22.0	1.3	20.7
April	31.7	3.2	28.5
May	23.1	4.4	18.7
June	29.3	8.9	20.4
July	56.0	10.0	46.0
August	53.2	10.0	43.2
September	60.6	8.0	52.6
October	56.6	5.3	51.3
November	46.4	5.3	41.1
December	56.5	6.9	49.6
Total	<u>435.4</u>	<u>63.3</u>	<u>372.1</u>

I. The Attack on Fixed Target System

During the period from 2 March 1965 through 19 February 1966 a total of 14,012 sorties delivered 12,960 tons of ordnance on JCS fixed targets, as indicated by the following tabulation:

<u>Type of Sortie</u>	<u>Sorties</u>		<u>Ordnance Delivered</u>	
	<u>Number</u>	<u>Percent</u>	<u>Tons</u>	<u>Percent</u>
Fixed target strike	11,064	79	11,960	92
Armed reconnaissance	2,948	21	1,000	8
Total	<u>14,012</u>	<u>100</u>	<u>12,960</u>	<u>100</u>

The attack on fixed targets accounted for approximately 33 percent of all Rolling Thunder sorties flown and 35 percent of all ordnance delivered on North Vietnam. Strikes were made on 142 fixed targets.

During the last three months of 1965, the number of fixed target strike sorties and the amount of ordnance delivered by them declined absolutely in comparison with previous levels and also declined relatively as a share of the total Rolling Thunder attack (see Figures B-12 and B-14). In the period from 31 January through 19 February, no fixed target strike sorties were flown, but 124 armed reconnaissance sorties restruck JCS targets that had been attacked previously. The increasingly important role of armed reconnaissance strike sorties in the total effort against JCS fixed targets in the last few weeks of 1965, and in the period after resumption of bombing in 1966, is evident in Figure B-9.

Significant data pertaining to the attack on individual JCS fixed target systems during the period 2 March-24 December 1965 are summarized graphically in Figures B-18 through B-32 and in Table B-14.* These figures present, for each of the major target systems, aggregate data concerning system capacity, number of targets struck, number of sorties flown, tons of ordnance delivered, losses of aircraft and personnel, and -- where possible -- the cost of the attacks and the estimated cost for restoration of the damaged installation. When possible, similar data were also presented for individual JCS targets within the target systems. Data pertaining to military complexes such as combination barracks and supply depots or barracks and ammunition depots have been summarized separately to provide alternatives for combination with data pertaining to other targets that fit properly into a single category.

J. Glossary**

Rolling Thunder - An unclassified codename applied to the entire airstrike program against North Vietnam.

Strike - An attack conducted by one or more aircraft.

Sortie - One operational flight by a single aircraft.

Combat Sortie - One aircraft airborne on a mission against the enemy.

* The data concerning attacks on ferries also were summarized, although these targets have been dropped from JCS Fixed Target List.

** Definitions are in accordance with those contained in the Joint Chiefs of Staff Armed Reconnaissance Study Group Report, An Analysis of the Armed Reconnaissance Program in North Vietnam, Appendix 3, Annex A, TOP SECRET/NO FOREIGN DISSEM.

Included are the following, defined as applicable within the Rolling Thunder program:

- a. Fixed Target Strike Sortie - One aircraft airborne on a primary mission against a pre-briefed JCS numbered target.
- b. Armed Reconnaissance Strike Sortie - One aircraft airborne with the primary mission of locating and attacking targets of opportunity -- that is, enemy material, personnel, and facilities in assigned general areas or along assigned lines of communication; or for attacks on pre-briefed small military targets, followed by armed route reconnaissance; or for restrikes on JCS numbered fixed targets.
- c. Flak Suppression Sortie - One aircraft airborne with a primary mission against enemy surface antiaircraft defenses.
- d. Other Combat Sorties - One aircraft airborne with a primary mission of air interdiction, close air support, or combat air patrol.

Combat Support Sortie - One aircraft airborne with the primary mission of providing operational assistance to combat elements. Included in the category are: escort, flare, refueling, bomb damage assessment, reconnaissance, air reconnaissance, photo-reconnaissance, pre-strike reconnaissance, search and rescue, weather reconnaissance, [REDACTED]

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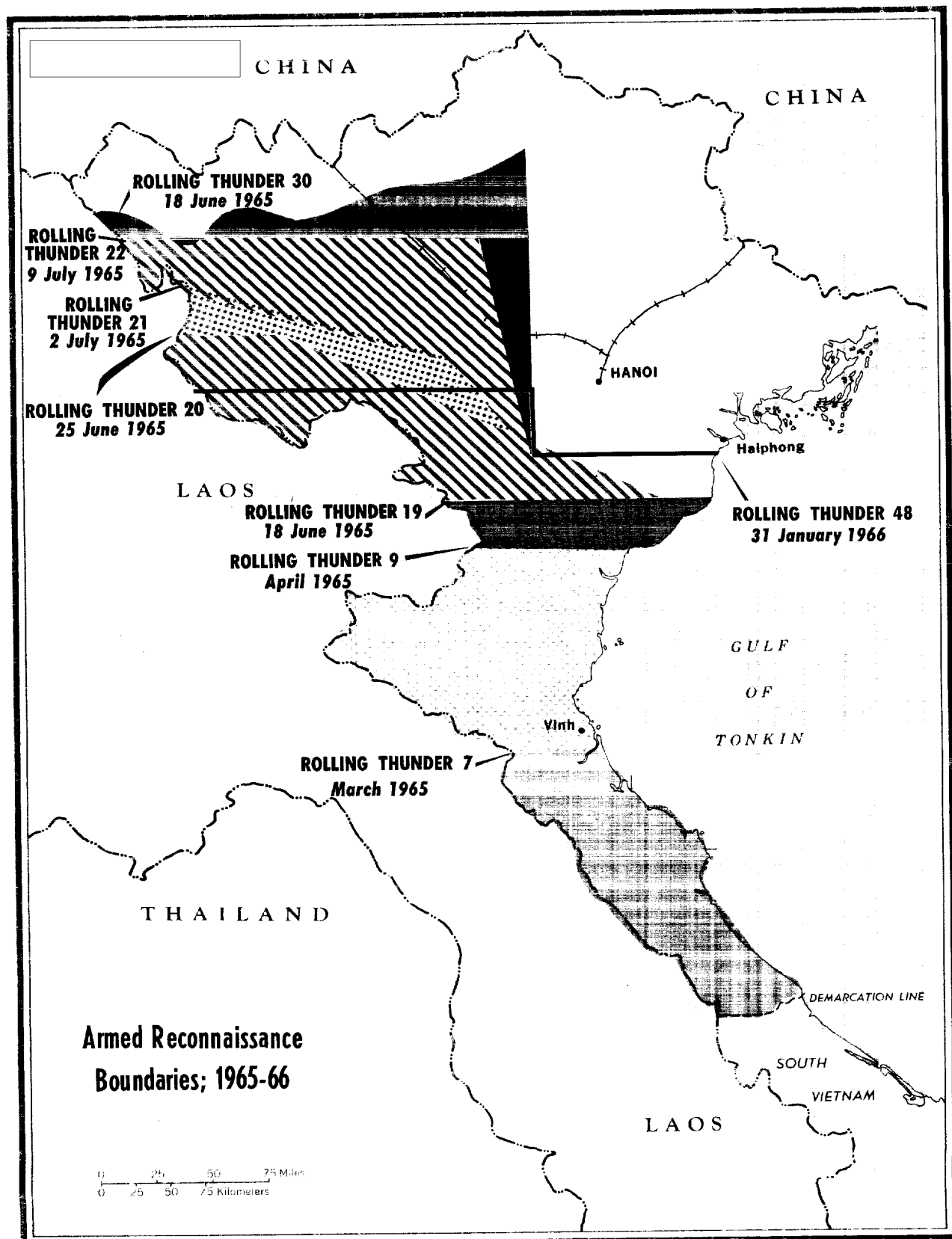
Table B-14

Rolling Thunder: Statistical Summary of Attacks
on Railroad Yards and Shops
2 March-24 December 1965

Number of targets	4 yards; 1 shop
Targets struck	2 yards (1 on JCS list; 1 not on JCS list)
Strikes	5
Attacking service	US Navy
Sorties	
Strike and flak suppression	75
Support	36
Total	<u>111</u>
Ordnance delivered	66 tons
Aircraft lost	2
Personnel lost	1
Personnel recovered	1
Cost to US	<u>Million US \$</u>
Aircraft lost	2.40
Operational cost of sorties flown	0.13
Ordnance expended	0.04
Total	<u>2.57</u>



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B-1 Rolling Thunder: Armed Reconnaissance Boundaries

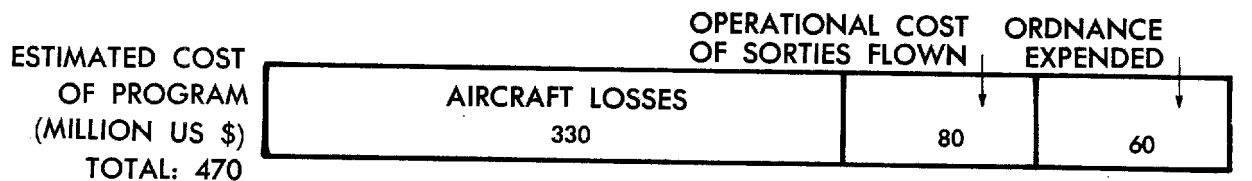
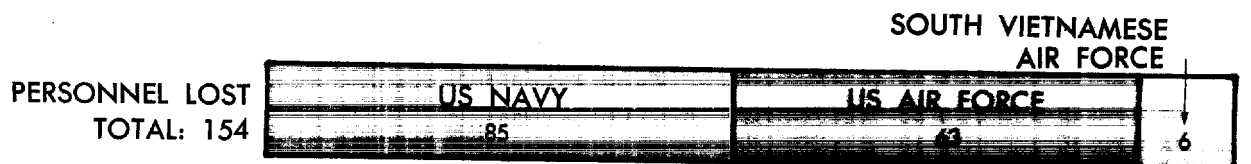
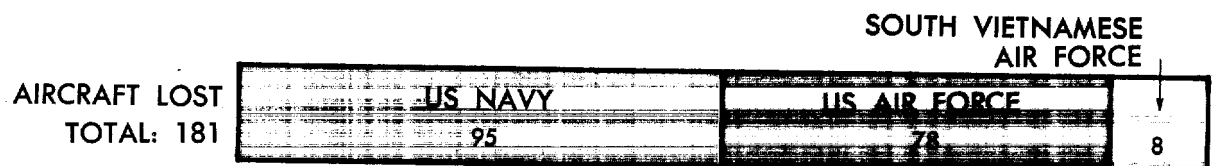
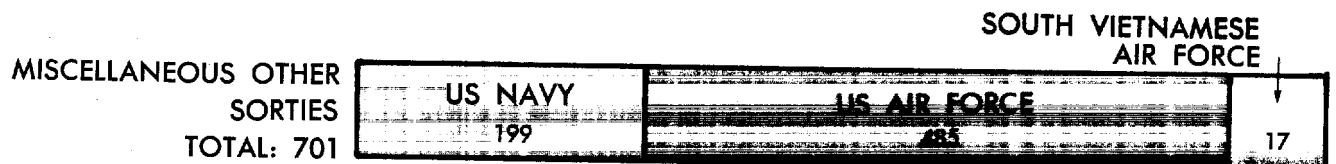
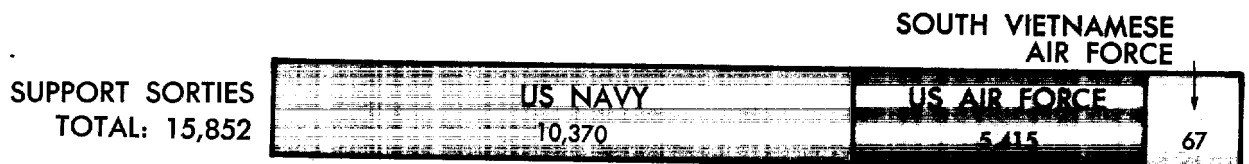
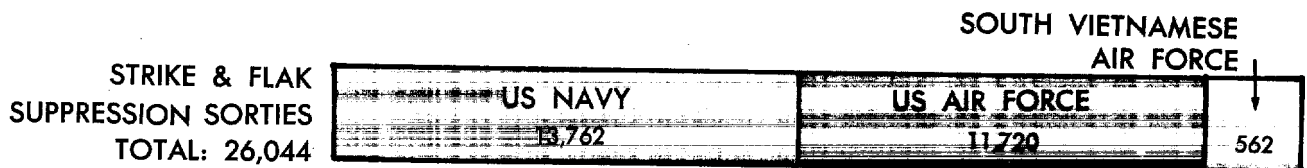
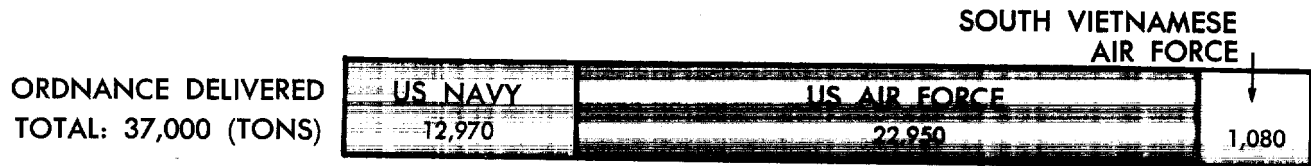
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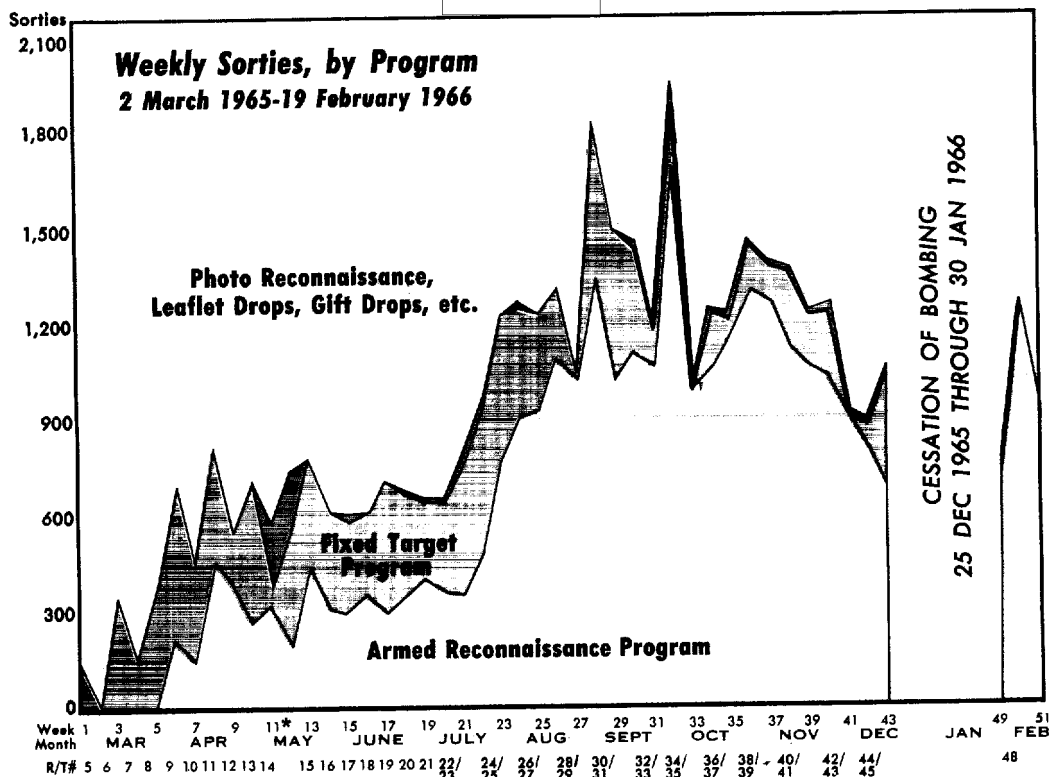
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ROLLING THUNDER**Statistical Summary, 2 March 1965-19 February 1966**

B-2 Rolling Thunder: Statistical Summary, 2 March 1965-19 February 1966

61353 25X1

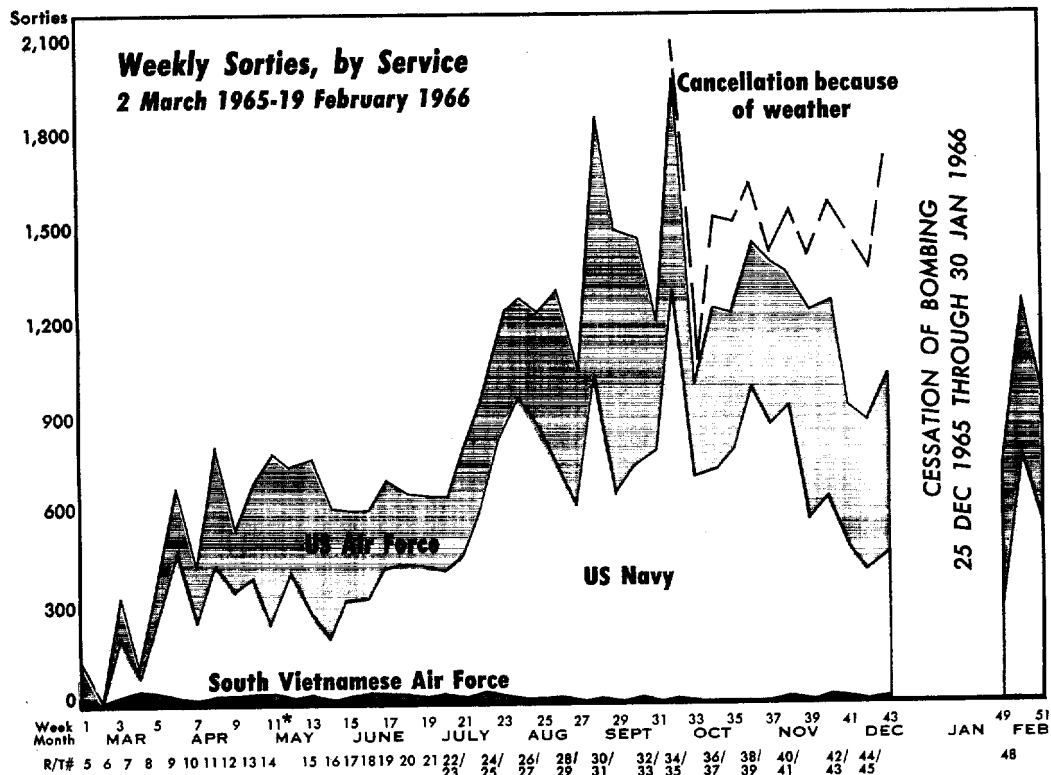
25X1



B-3 Rolling Thunder: Weekly Summary of Sorties, by Program
2 March 1965-19 February 1966

61354

* Five day suspension of bombing



B-4 Rolling Thunder: Weekly Summary of Sorties, by Service
2 March 1965-19 February 1966

61355

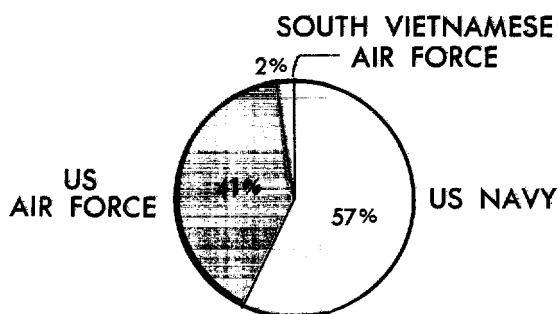
25X1

SECRET

ROLLING THUNDER

Sorties Flown, 2 March 1965-19 February 1966

SERVICE	NUMBER OF SORTIES
US NAVY	24,331—57%
US AIR FORCE	17,620—41%
SOUTH VIETNAMESE AIR FORCE	646— 2%
TOTAL	42,597



COMBAT SORTIES

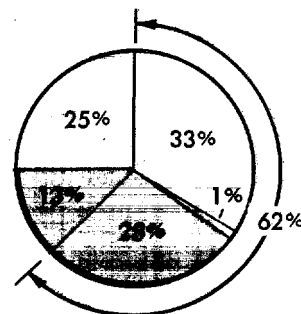
STRIKE & FLAK SUPPRESSION SORTIES: 26,044— 62%

US NAVY	13,762—33%
US AIR FORCE	11,720—28%
SOUTH VIETNAMESE AIR FORCE	562— 1%

SUPPORT SORTIES:

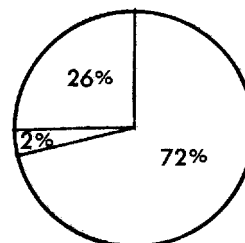
US NAVY	10,370—25%
US AIR FORCE	5,415—13%
SOUTH VIETNAMESE AIR FORCE	67—NEGL.
TOTAL	41,896—100%

15,852— 38%



PROGRAM

FIXED TARGET SORTIES	11,064— 26%
ARMED RECONNAISSANCE SORTIES	30,832— 72%
LEAFLET DROPS, PHOTO RECON- NAISSANCE, GIFT DROPS, ETC.	701— 2%
TOTAL	42,597—100%



B-5 Rolling Thunder: Sorties Flown, 2 March 1965-19 February 1966

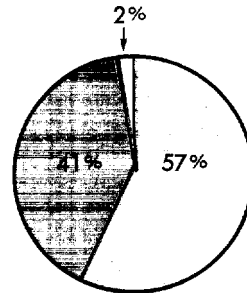
61356

SECRET

ROLLING THUNDER

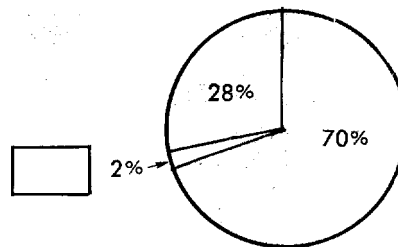
Sorties Flown, 2 March 1965-24 December 1965

SERVICE	NUMBER OF SORTIES
U S NAVY	22,685
U S AIR FORCE	16,310
SOUTH VIETNAMESE AIR FORCE	646
TOTAL	39,641



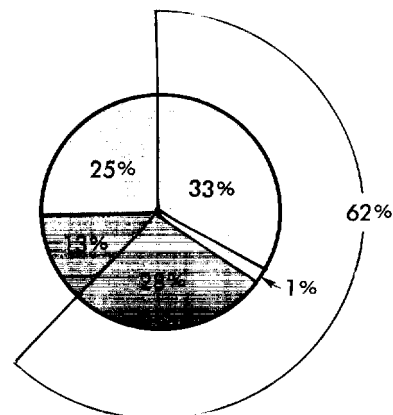
PROGRAM

FIXED TARGET SORTIES	11,064
ARMED RECONNAISSANCE SORTIES	27,932
LEAFLET DROPS, PHOTO RECON- NAISSANCE, GIFT DROPS, ETC.	645
TOTAL	39,641



COMBAT SORTIES

STRIKE AND FLAK SUP - 24,057 - 62%	
PRESSION SORTIES	
USN	12,728 - 33%
USAF	10,767 - 28%
VNAF	562 - 1%
SUPPORT SORTIES 14,939 - 38%	
USN	9,758 - 25%
USAF	5,114 - 13%
VNAF	67 - NEGL.
TOTAL	38,996 - 100%

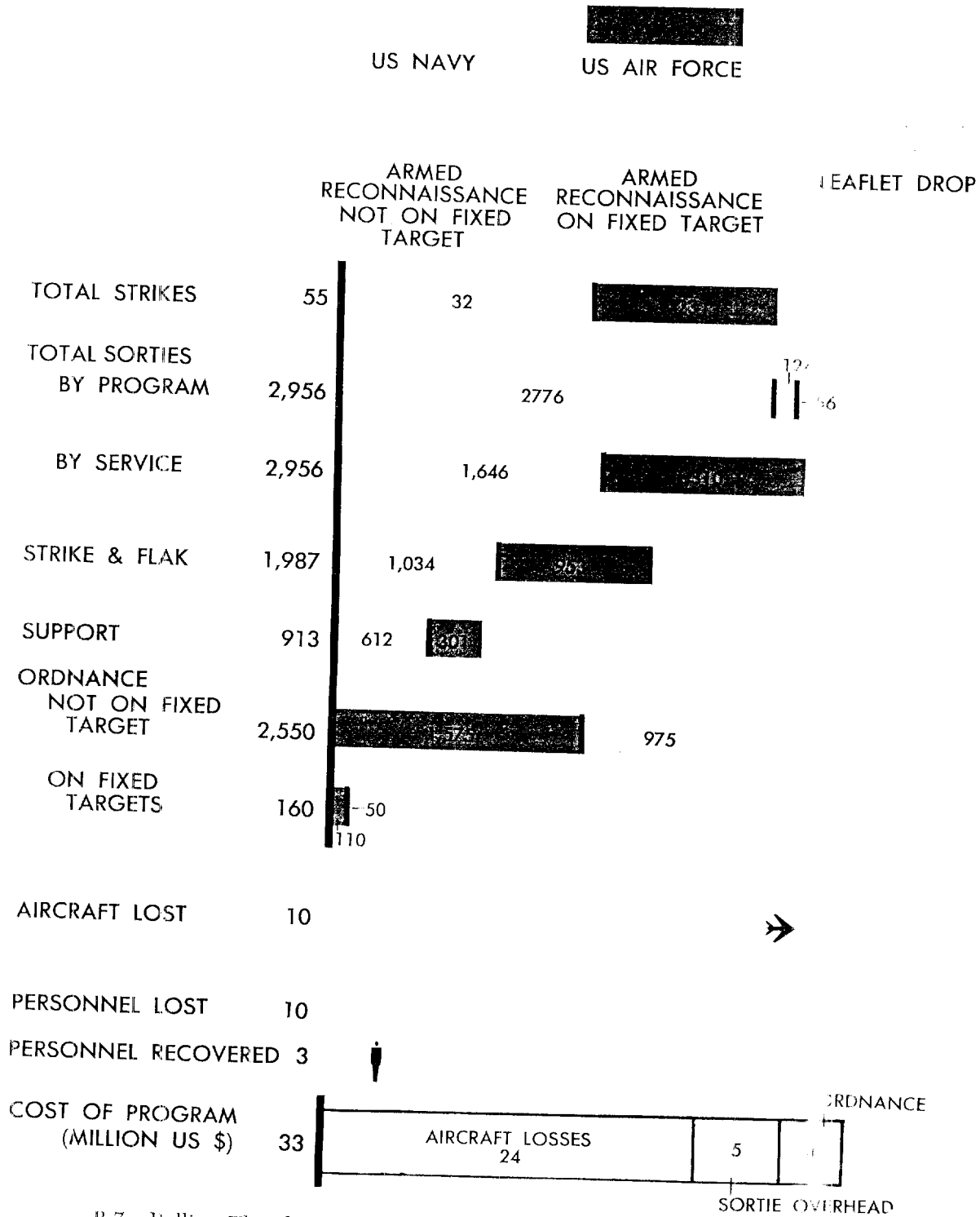


B-6 Rolling Thunder: Sorties Flown, 2 March-24 December 1965

ROLLING THUNDER

Statistical Summary, 31 January - 19 February 1966

25X1

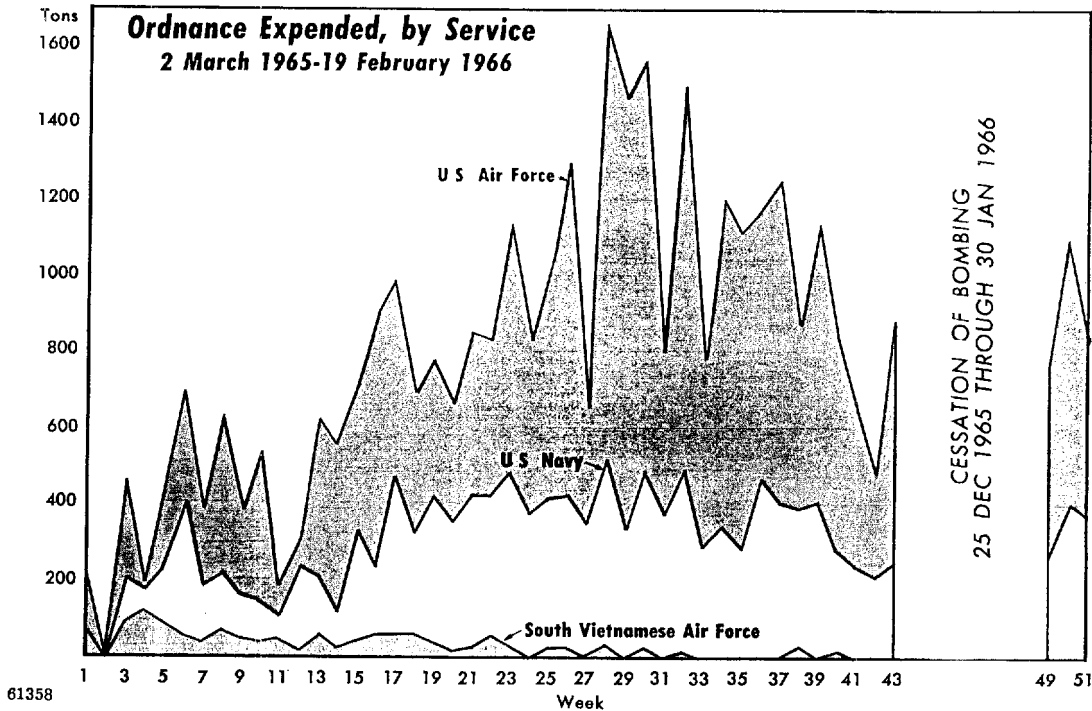


B-7 Rolling Thunder: Statistical Summary, 31 January - 19 February 1966

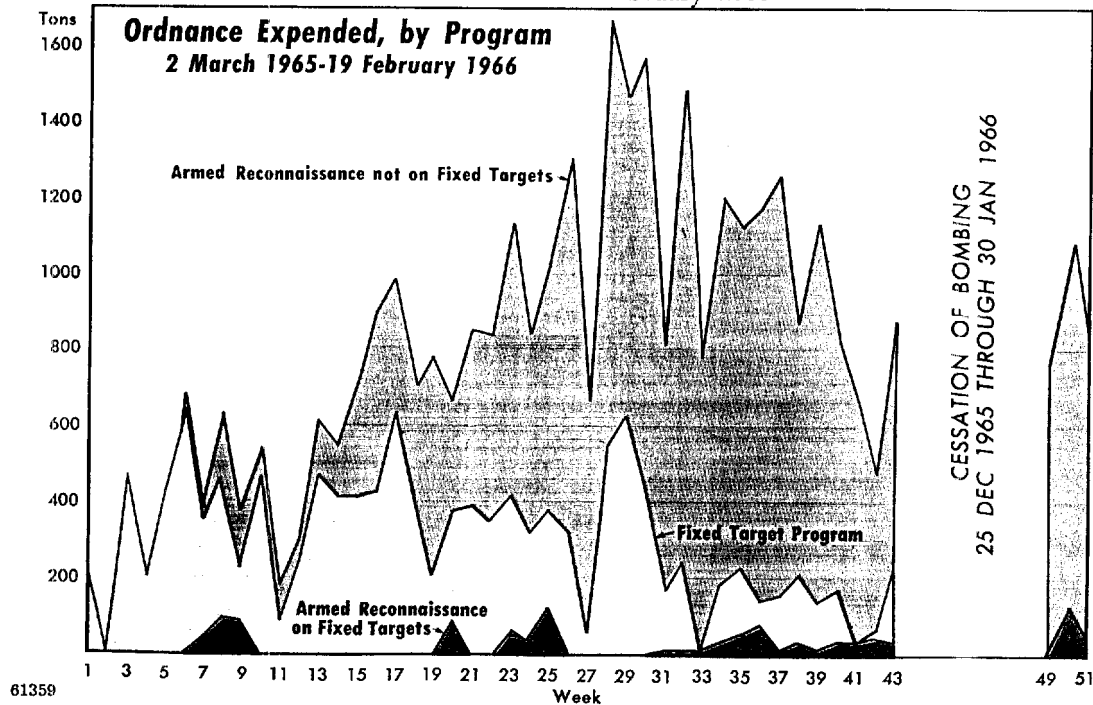
61358

25X1

25X1



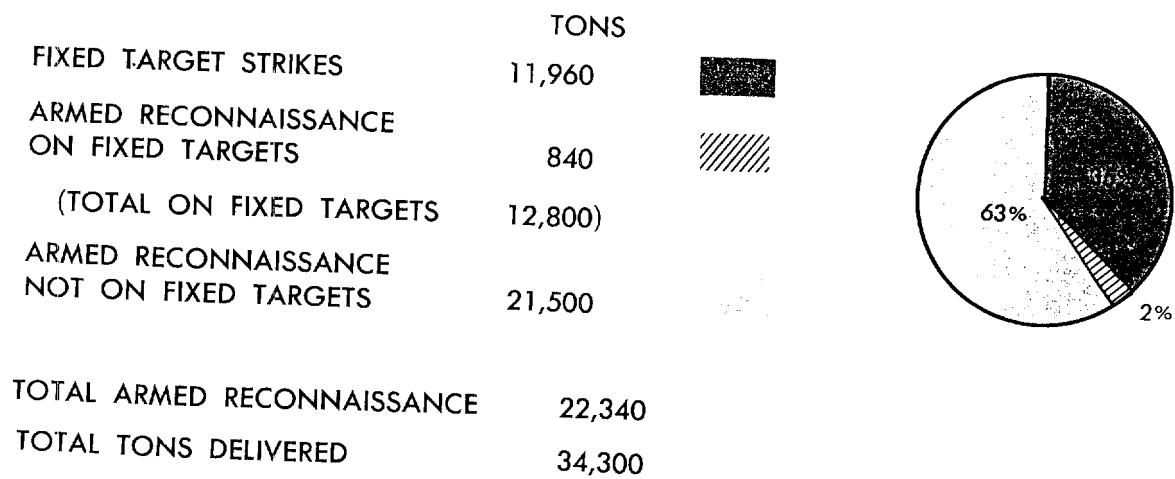
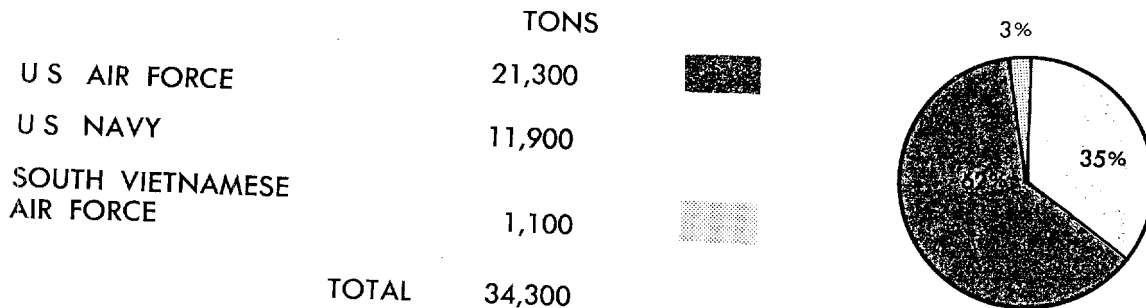
B-8 Rolling Thunder: Weekly Summary of Ordnance Expended, by Service
2 March 1965-19 February 1966



B-9 Rolling Thunder: Weekly Summary of Ordnance Expended, by Program
2 March 1965-19 February 1966

25X1

ROLLING THUNDER
Ordnance Expended, 2 March-24 December 1965



B-10 Rolling Thunder: Ordnance Expended, 2 March-24 December 1965

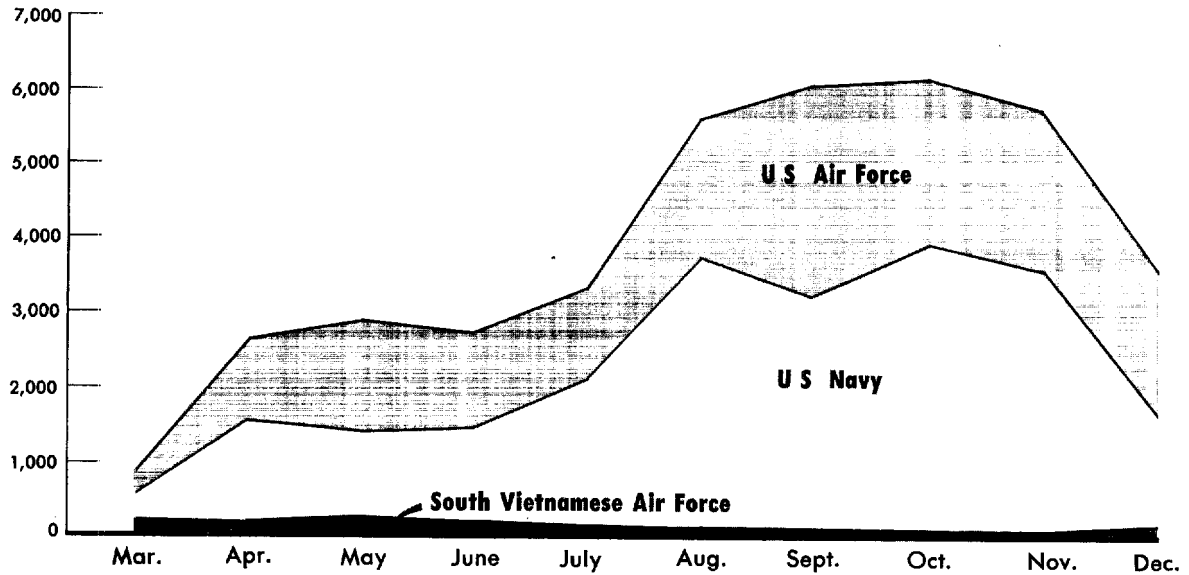
61361

25X1

25X1



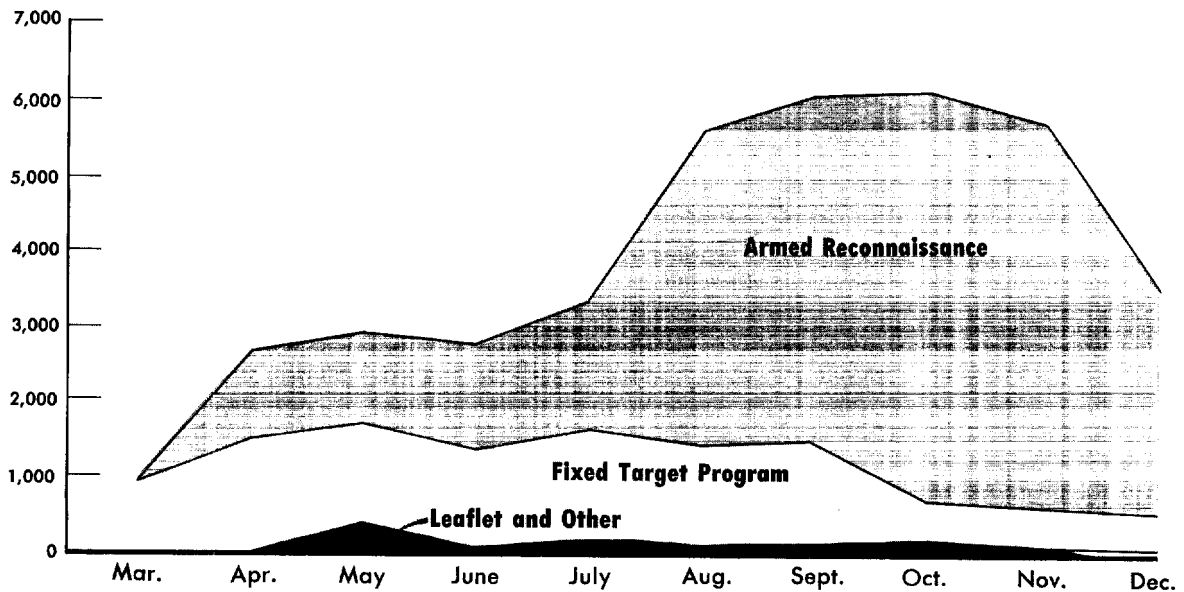
Sorties, by Service



B-11 Rolling Thunder: Monthly Summary of Sorties, by Service, March-December 1965

61361 3-66 CIA

Sorties, by Program



B-12 Rolling Thunder: Monthly Summary of Sorties, by Program, March-December 1965

61362

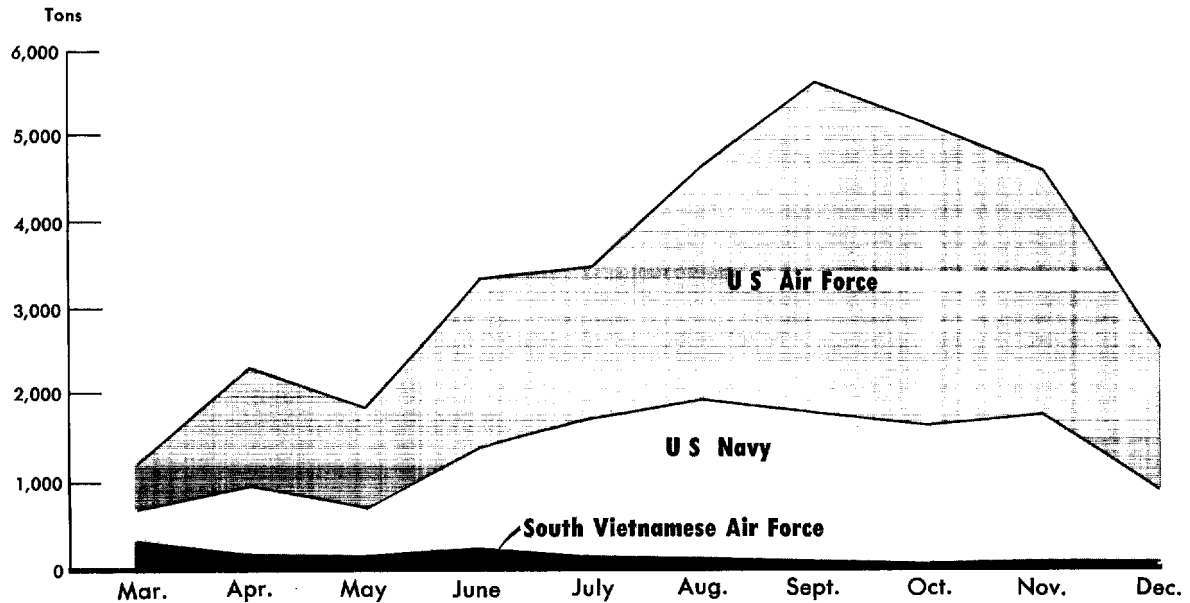


25X1

25X1



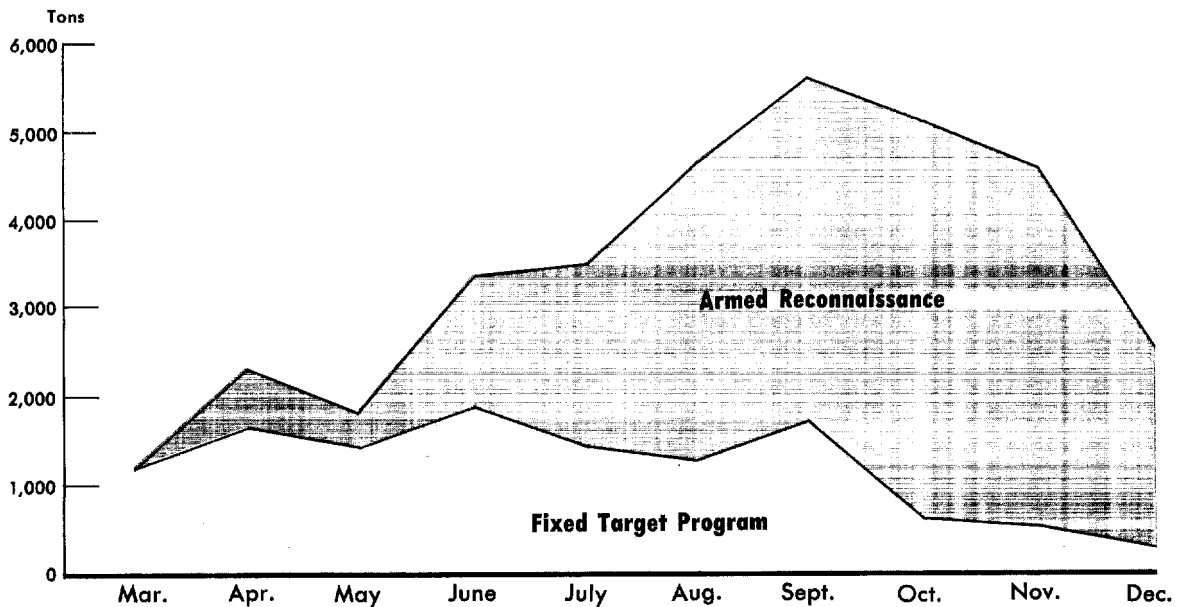
Ordnance Expended, by Service



B-13 Rolling Thunder: Monthly Summary of Ordnance Expended, by Service, March-December 1965

61363 3-66 CIA

Ordnance Expended, by Program

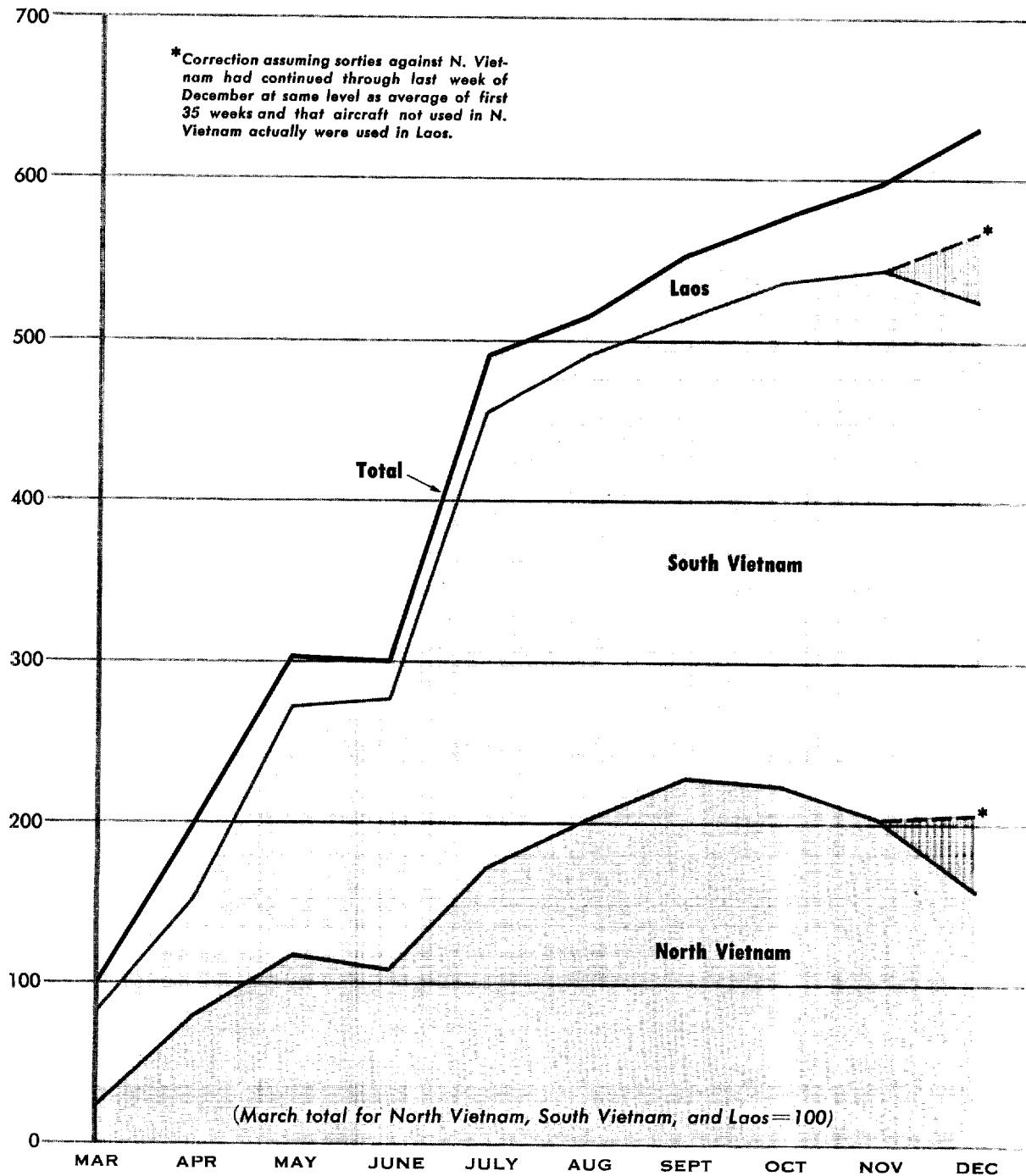


B-14 Rolling Thunder: Monthly Summary of Ordnance Expended, by Program, March-December 1965

61364 3-66 CIA



25X1

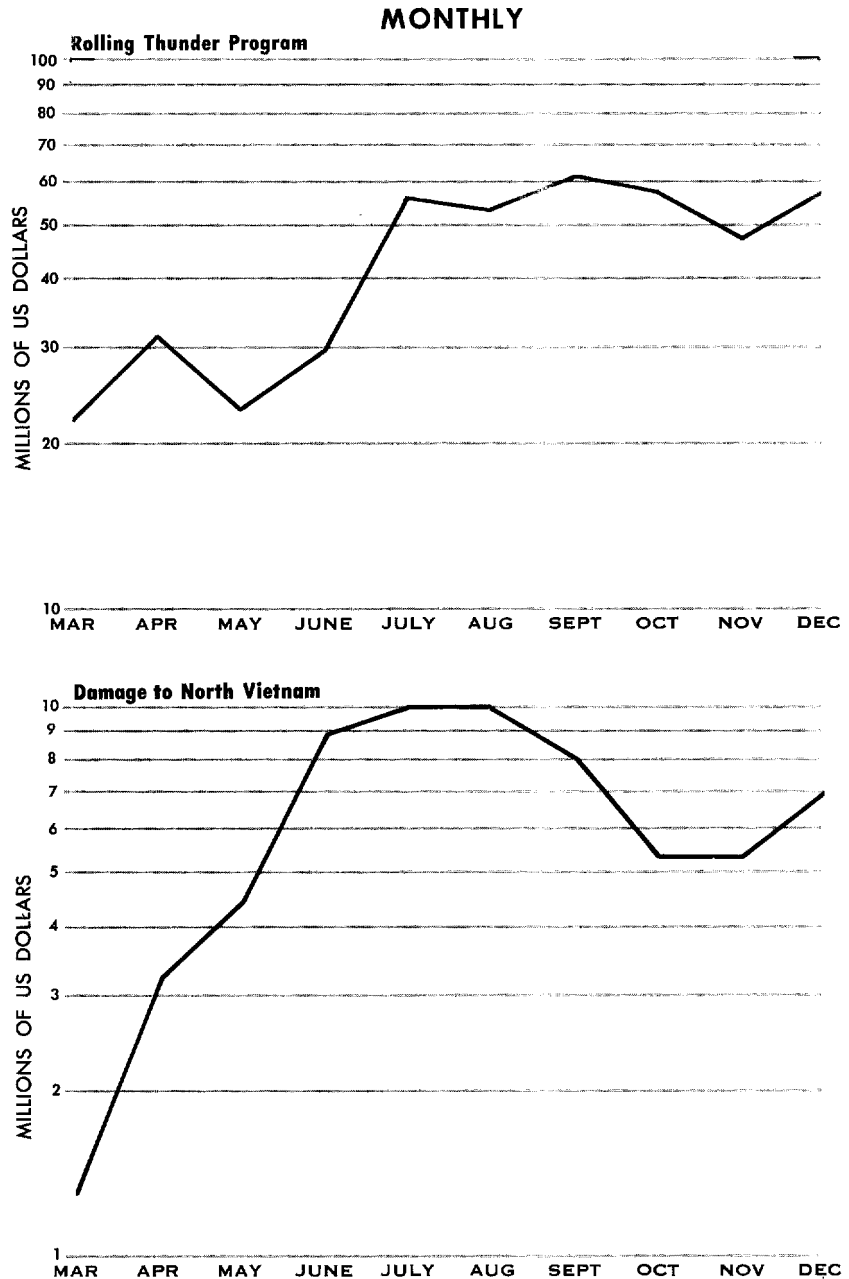
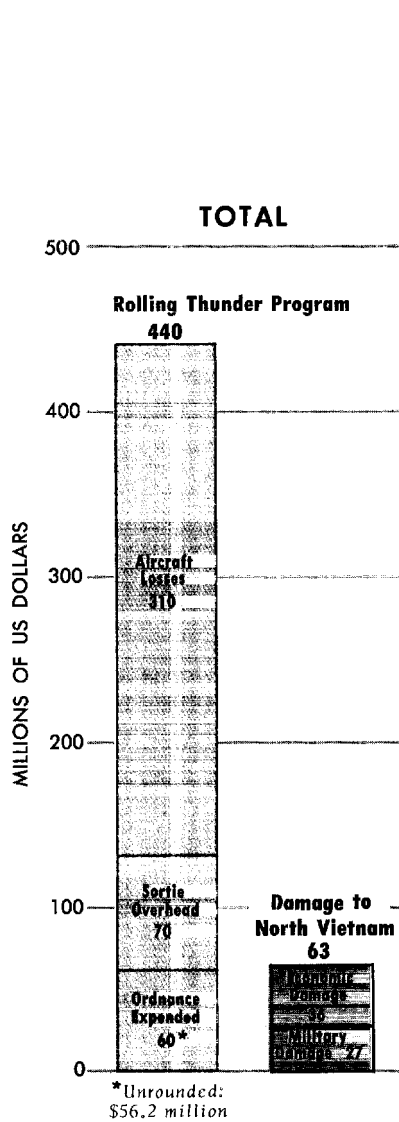
Indexes of Sorties Flown in Southeast Asia

B-15 Indexes of Sorties Flown in Southeast Asia and the Relative Amount in Each Area
March-December 1965

61385

25X1

Cost Related to the Cost of Damage



B-16, B-17 Estimated Cost of Rolling Thunder Related to the Cost of Damage to the Economy of North Vietnam
2 March-24 December 1965

61386

25X1

ROLLING THUNDER:**Attacks on Airfields, 2 March -24 December 1965**

U S AIR FORCE

U S NAVY

SOUTH VIETNAMESE
AIR FORCE

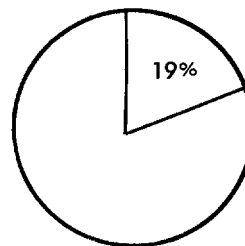
PROGRAMED IN TIS

TARGETS ATTACKED: 4

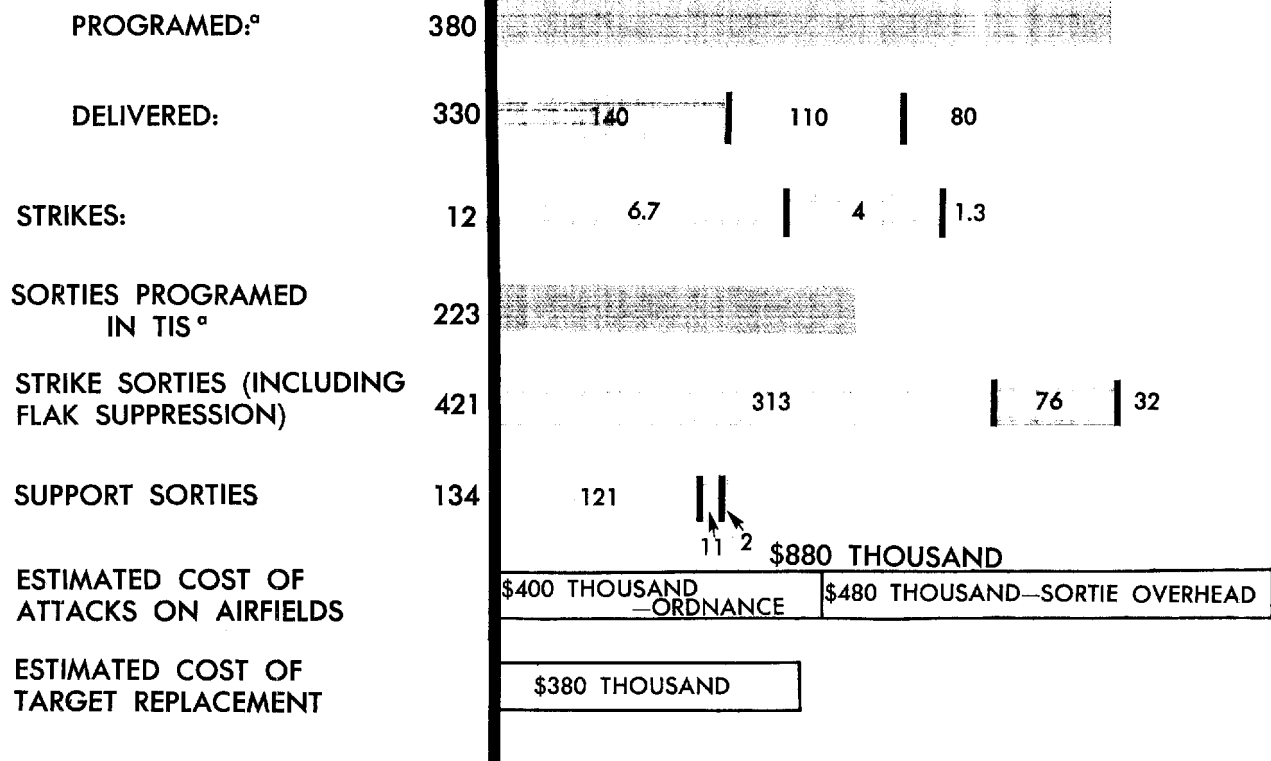


KNOWN AIRFIELDS: 22

AIRFIELDS TARGETED: 11

% CAPACITY OF TARGETED
AIRFIELDS DESTROYED: 19

ORDNANCE (TONS)



a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

25X1

ROLLING THUNDER**Attacks on Airfields, 2 March-24 December 1965**

US AIR FORCE

US NAVY

SOUTH VIETNAMESE
AIR FORCE

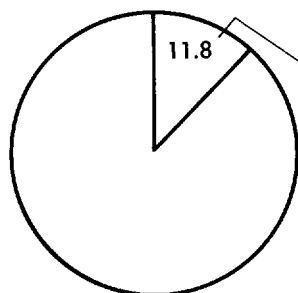
PROGRAMED IN TIS

AIRFIELD	CAPACITY % TARGETED	CAPACITY % DESTROYED OR INACTIVE	ORDNANCE—TIS & ACTUAL WEIGHT IN TONS; COST OF BOMBS EXPENDED	SORTIES
NA SAN	4	4	100	29 STRIKE AND FLAK
			70	5 SUPPORT
			\$95,000	62
DIEN BIEN PHU	3	3	85	49 STRIKE AND FLAK
			70	51
			\$75,000	
DONG HOI	6	6	160	180 STRIKE AND FLAK 12
			75 25 10 110	32 136
			\$115,000	2 75 6 83 SUPPORT
VINH	6	6	30	STRIKE AND FLAK
			80	177
			\$95,000	46 SUPPORT

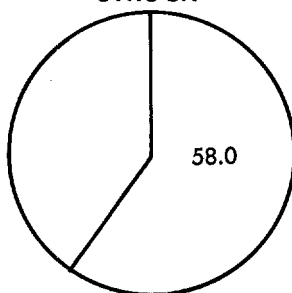
B-18 b Rolling Thunder: Statistical Summary of Attacks on Airfields, 2 March-24 December 1965

61386

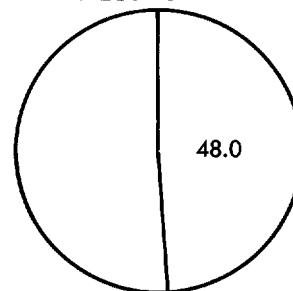
25X1

ROLLING THUNDER**Attacks on Bridges, 2 March-24 December 1965****% NORTH VIETNAMESE BRIDGES****TARGETED**

REPRESENTS 61 BRIDGES
TARGETED FROM A TOTAL OF
519 IN NORTH VIETNAM

**% TARGETED CAPACITY
STRUCK***

* REPRESENTS 44 BRIDGES ACTUALLY
STRUCK OF THE 63^a ORIGINALLY
TARGETED. THESE 44 BRIDGES
COMPRISED APPROX. 58.0% OF
TARGETED CAPACITY

**% TARGETED CAPACITY
DESTROYED**

U S NAVY

U S AIR FORCE

SOUTH VIETNAMESE
AIR FORCEPROGRAMED^b

STRIKE SORTIES (INCLUDING
FLAK SUPPRESSION SORTIES)
ACTUAL

1400

58%

975 50

2%

TOTAL 2425

PROGRAMED^b

TOTAL 2308

SUPPORT SORTIES

837

48%

874 2

1%

TOTAL 1713

ORDNANCE (TONS)

1293

40%

1770

135

5%

TOTAL 3198

PROGRAMED^b

TOTAL 4898

^a TWO BRIDGES HAVE BEEN DROPPED SUBSEQUENTLY FROM THE TARGET LIST.

^b UPPER LIMIT OF THE RANGE OF ORDNANCE AND SORTIES GIVEN IN THE TARGET INFORMATION SUMMARY (TIS) OF THE JOINT CHIEFS OF STAFF AS THE OPERATIONAL REQUIREMENTS FOR 70% DESTRUCTION OF THE TARGET

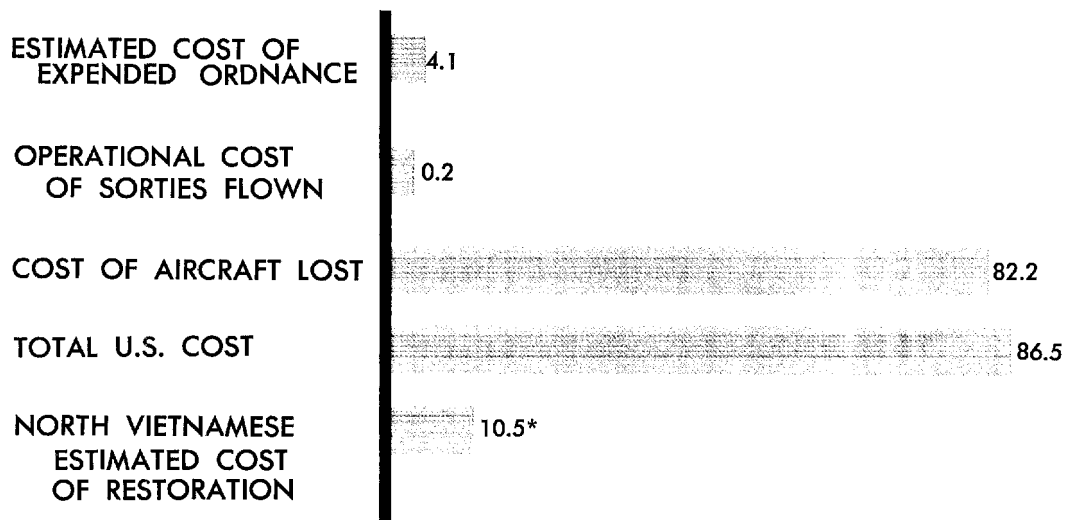
25X1

ROLLING THUNDER
Attacks on Bridges, 2 March -24 December 1965

LOSSES:

PLANES	US NAVY	17 [46%]
▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲	US AIR FORCE	17 [46%]
	SOUTH VIETNAMESE	
	AIR FORCE	3 [8%]
	TOTAL	37
PERSONNEL		
LOST	US NAVY	18 [51%]
■■■■■■■■■■■■■■■■■■■■	US AIR FORCE	14 [40%]
	SOUTH VIETNAMESE	
	AIR FORCE	3 [9%]
	TOTAL	35
RECOVERED	US NAVY	5
■■■■	US AIR FORCE	4
	SOUTH VIETNAMESE	
	AIR FORCE	0
	TOTAL	9

COMPARATIVE COST
MILLION US \$



*INCLUDING COST OF RESTORATION OF
 BRIDGES NOT ON JCS-TARGET LIST.

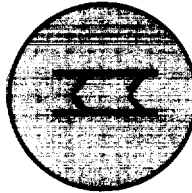
ROLLING THUNDER

Attacks on Locks, 2 March 1965-24 December 1965

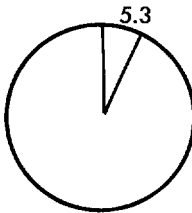
U S AIR FORCE

PROGRAMED IN TIS

TARGETS ATTACKED: 1



NUMBER OF LOCKS TARGETED: 8
% TARGET CAPACITY DESTROYED: 5.3



ORDNANCE: (TONS)
PROGRAMED ON TIS^a

120

TONS DROPPED:

20

STRIKES:

2

STRIKE SORTIES: (INCLUDES
FLAK SUPPRESSION)

PROGRAMED IN TIS^a

51

ACTUAL:

10

SUPPORT SORTIES:

7

AIRCRAFT LOST:

0

ESTIMATED COST OF
ATTACKS ON LOCKS

\$100 THOUSAND

\$70 THOUSAND

\$30 THOUSAND

SORTIE OVERHEAD ORDNANCE

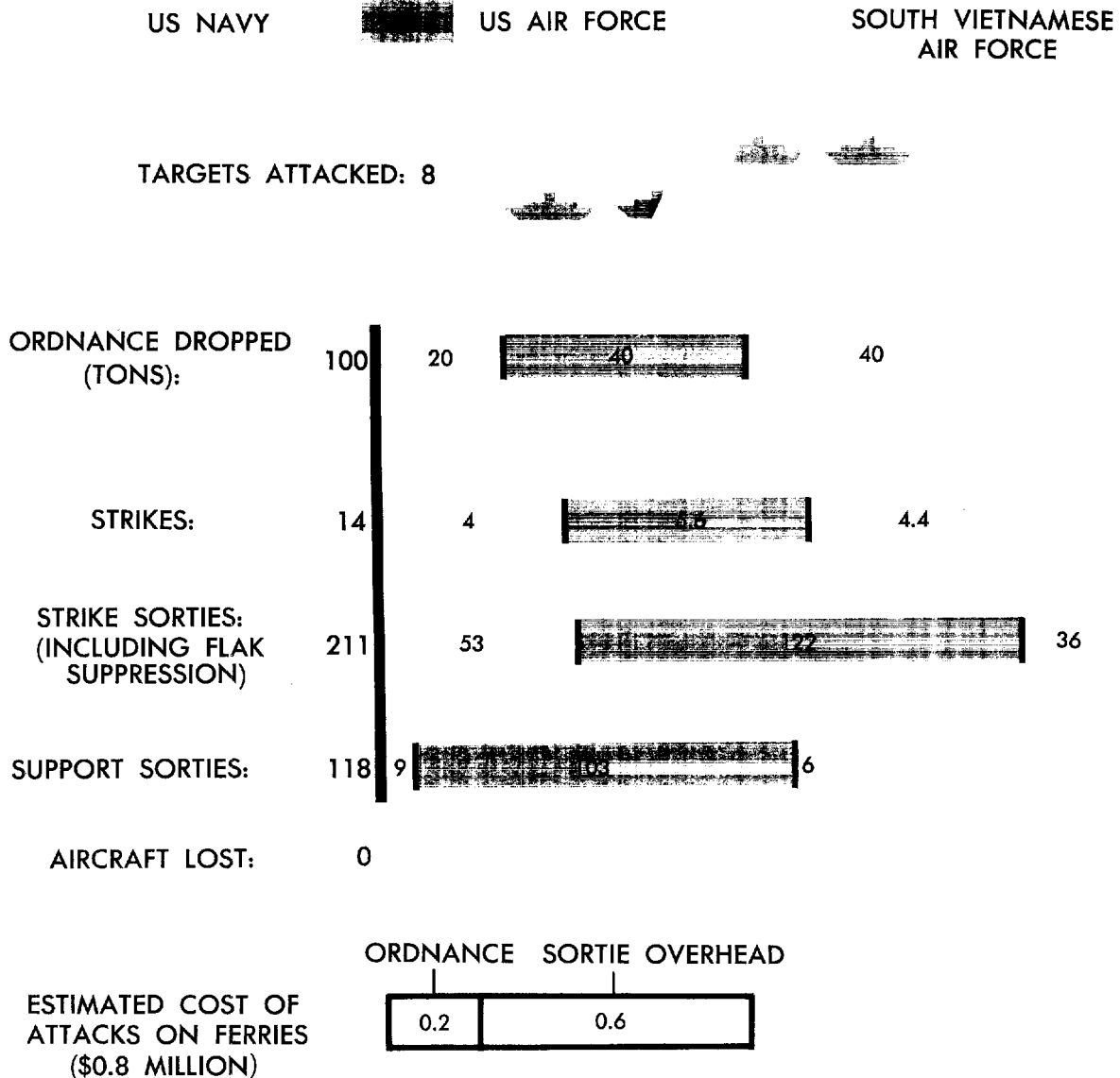
a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

B-20 Rolling Thunder: Statistical Summary of Attacks on Locks, 2 March-24 December 1965

25X1

ROLLING THUNDER

Attacks on Ferries,* 2 March-24 December 1965



*FERRIES ARE NO LONGER JCS TARGETS

B-21 Rolling Thunder: Statistical Summary of Attacks on Ferries, 2 March-24 December 1965

61372

25X1

25X1

ROLLING THUNDER
Attacks on Barracks,* 2 March 1965-24 December 1965

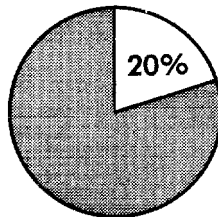
U S NAVY

U S AIR FORCE

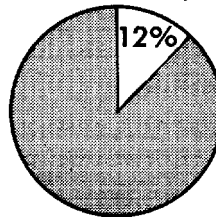
SOUTH VIETNAMESE
AIR FORCE

PROGRAMED IN TIS

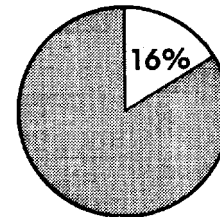
TOTAL NATIONAL BARRACKS
CAPACITY 443,000 TROOPS
TARGETED 180,000 TROOPS



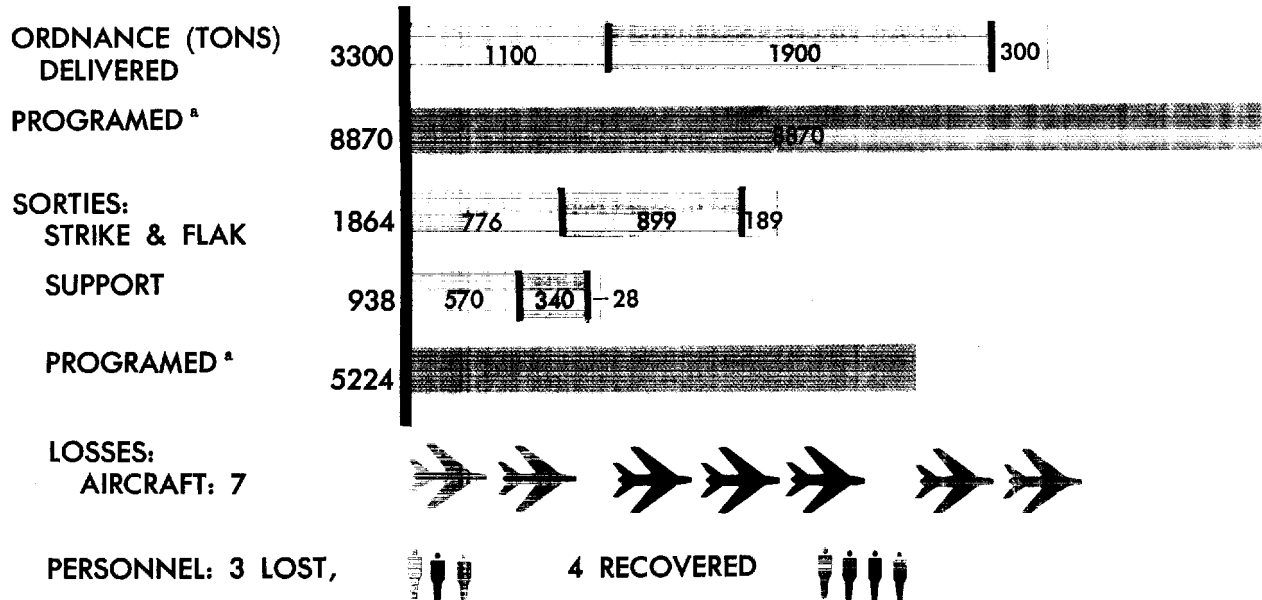
NATIONAL CAPACITY
STRUCK



PROGRAMED NATIONAL
CAPACITY DESTROYED



ACTUAL NATIONAL CAPACITY
DESTROYED OR INACTIVE



* UPPER LIMIT OF THE RANGE OF ORDNANCE AND SORTIES GIVEN IN THE TARGET INFORMATION SUMMARY (TIS) OF THE JOINT CHIEFS OF STAFF AS THE OPERATIONAL REQUIREMENTS FOR 70% DESTRUCTION OF THE TARGET

*EXCLUDING COMBINED BARRACKS/AMMUNITION DEPOTS AND BARRACKS/SUPPLY

ESTIMATED COST TO US	SORTIE OVERHEAD		
	ORDNANCE		
	\$18.6 MILLION LOST AIRCRAFT	\$3.8 MILLION	\$5.2 MILLION
	TOTAL \$27.6 MILLION		
ESTIMATED COST OF TARGET REPLACEMENT	DAMAGE TO BARRACKS		
	TOTAL \$16 MILLION		

B-22 Rolling Thunder: Statistical Summary of Attacks on Barracks
 2 March-24 December 1965

61373

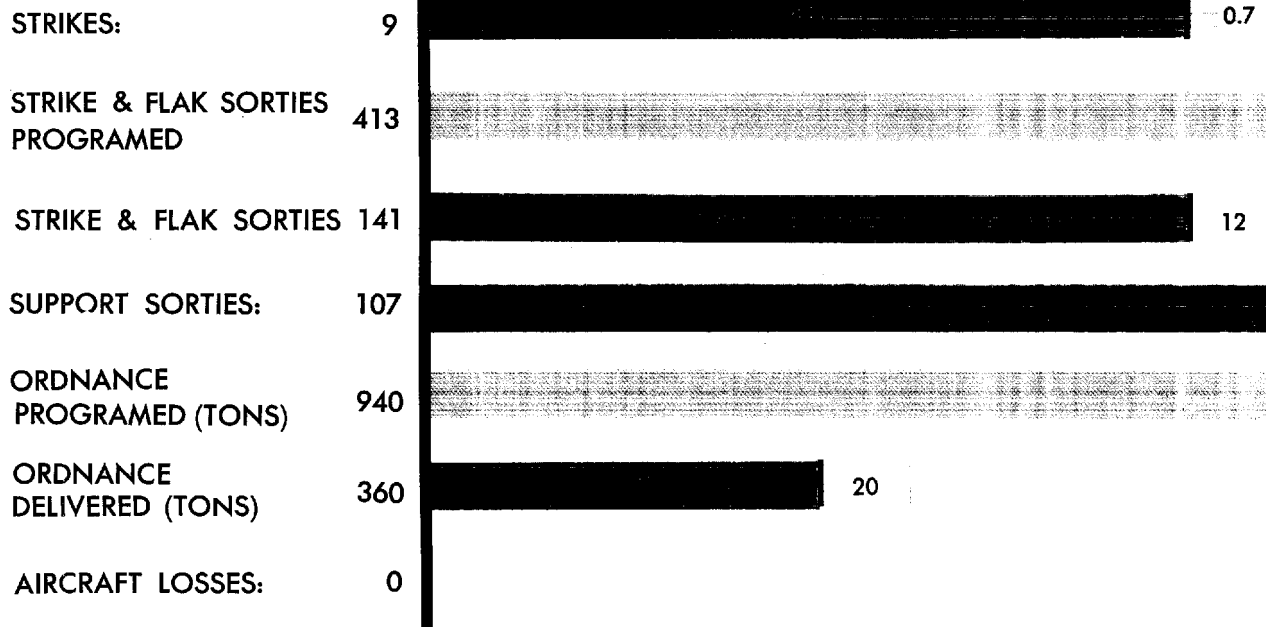
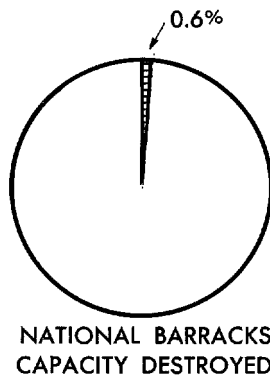
25X1

25X1

ROLLING THUNDER

Attacks on Combined Barracks and Ammunition Depots

U S AIR FORCE SOUTH VIETNAMESE AIR FORCE PROGRAMED IN TIS *



COST OF ORDNANCE DROPPED: \$0.5 MILLION

OPERATIONAL COST OF SORTIES FLOWN: \$ 0.7 MILLION

a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

Note: Also see Fig. B-22 & Fig. B-24

B-23 Rolling Thunder: Statistical Summary of Attacks on Combined Barracks and Ammunition Depots 2 March-24 December 1965

61374

25X1

Attacks on Ammunition Depots,* 2 March-24 December 1965

[illegible]

A pie chart with a single slice removed, representing 73% of the total.

Gender	Percentage
Male	60%
Female	40%

PROGRAMED DESTRUCTION 52%

1. The first step is to identify the variables that are being measured. In this case, the variables are the number of people who are infected and the number of people who are recovered.

11

100-447689-1

336

REPORT OF THE SECRETARY OF DEFENSE

151

[illegible]

[The following text is extremely faint and largely illegible due to low contrast and blurring. It appears to be a continuation of the document's content, possibly a list or a detailed description.]

342

[illegible]

SORTIE OVERHEAD

\$3.0

\$4.1

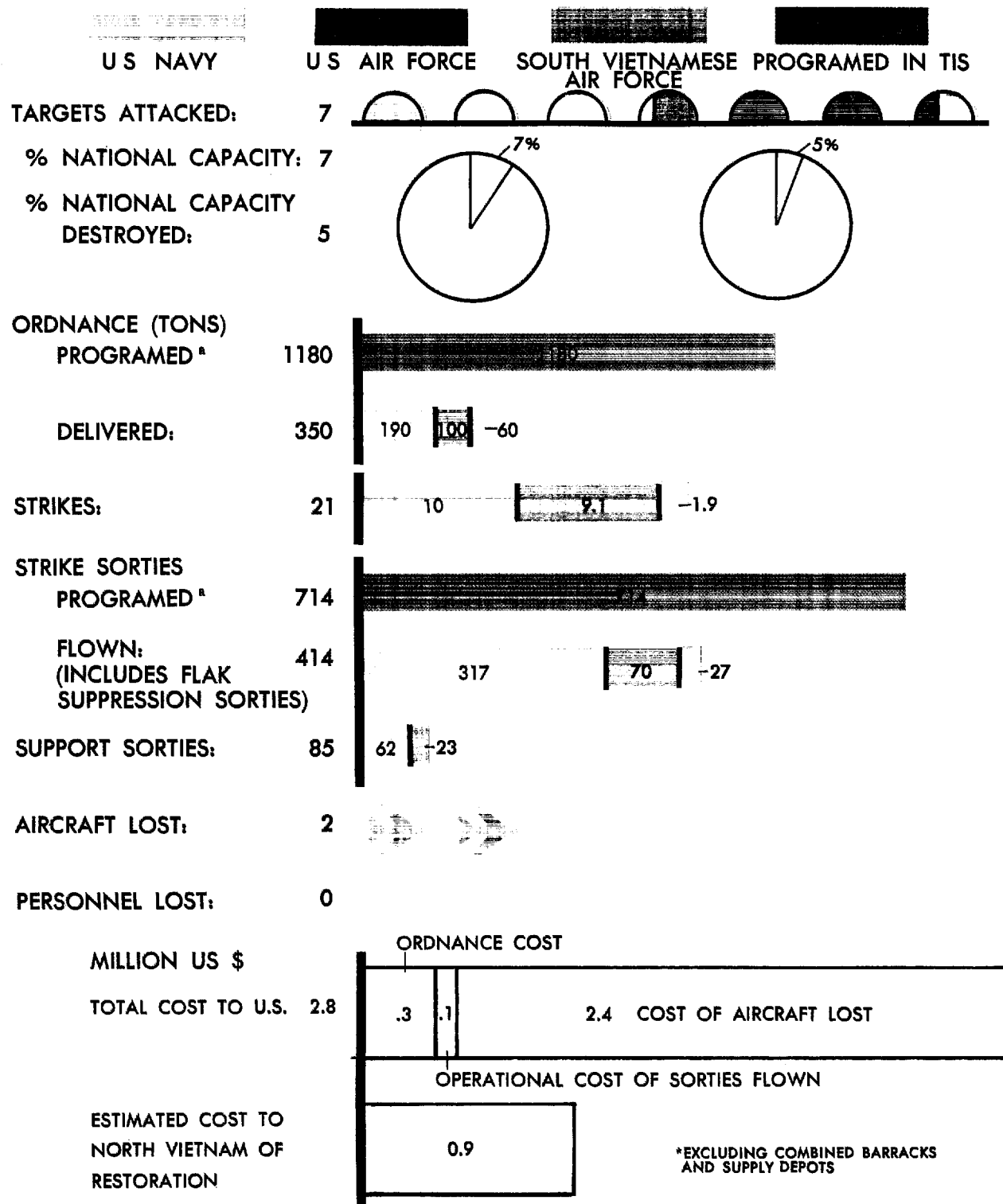
a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

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Approved For Release 2009/04/23 : CIA-RDP78T02095R000900070017-0

25X1

ROLLING THUNDER
Attacks on Supply Depots,* 2 March -24 December 1965



^a Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

B-25 Rolling Thunder: Statistical Summary of Attacks on Supply Depots *
 2 March-24 December 1965

61376

25X1

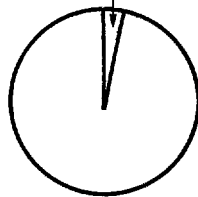
25X1

ROLLING THUNDER**Attacks on Combined Barracks and Supply Depots 2 March -24 December 1965**

U.S. AIR FORCE U.S. NAVY SOUTH VIETNAMESE AIR FORCE PROGRAMED IN TIS

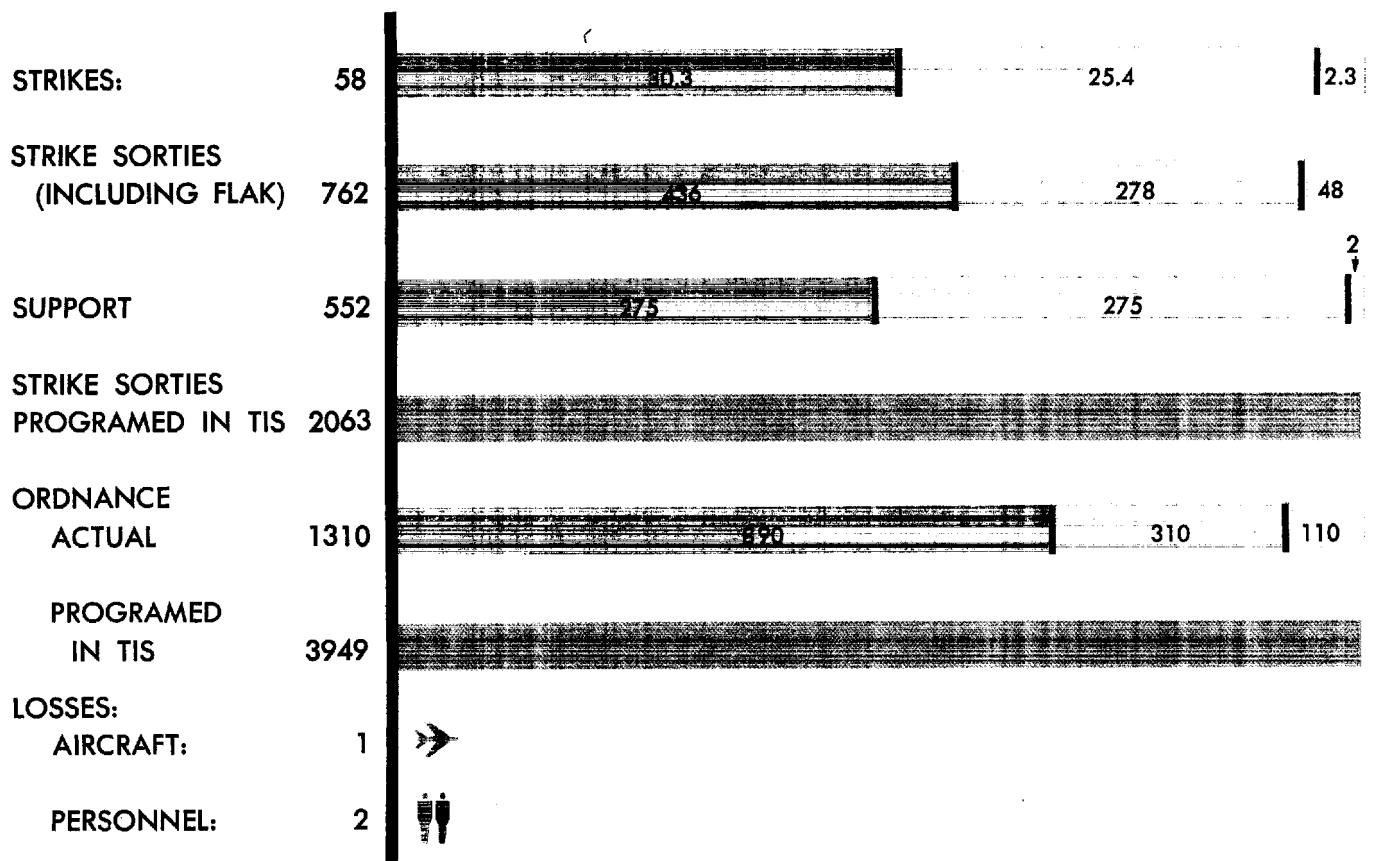
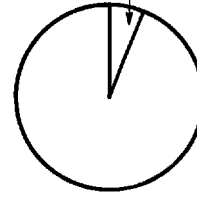
NATIONAL BARRACKS
CAPACITY DESTROYED

2.4%



NATIONAL STORAGE
CAPACITY DESTROYED

6%



COST OF ORDNANCE DROPPED: \$1.5 MILLION

COST OF AIRCRAFT LOST: \$2.1 MILLION

OPERATIONAL COST OF SORTIES FLOWN: \$1.1 MILLION

B-26 Rolling Thunder: Statistical Summary of Attacks on Combined Barracks and Supply Depots
2 March-24 December 1965

6137 25X1

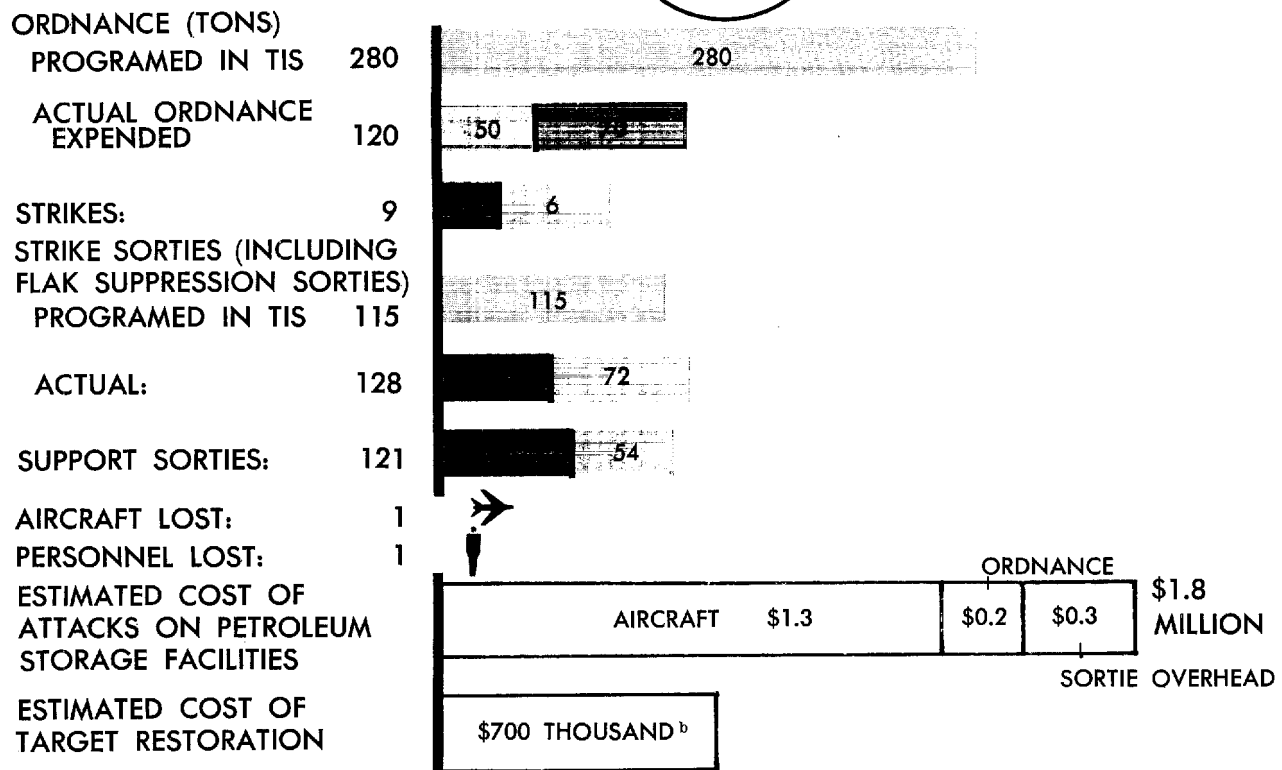
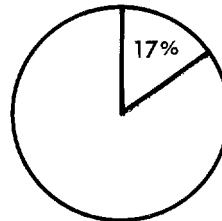
ROLLING THUNDER**Attacks on Bulk Petroleum Storage Facilities, 2 March-24 December 1965**

US NAVY US AIR FORCE PROGRAMED IN TIS ^a

TARGETS ATTACKED: 4



TOTAL NATIONAL CAPACITY:
216,000 METRIC TONS
% NATIONAL CAPACITY DESTROYED:
17



a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

b) Includes \$210 thousand worth of damage inflicted in August, 1964.

BULK STORAGE SITE	CAPACITY 000 (MT) % NAT CAP	ORDNANCE	SORTIES
PHU VAN	1 NEGL.	WEIGHT IN TONS COST OF ORDNANCE	STRIKE & FLAK SUPPORT
VINH	18 8	20 60 \$75,000	18 42 27 69
NAM DINH	12 6	15 8 \$41,000	28 26
PHU QUI	10 5	20 \$63,000	6

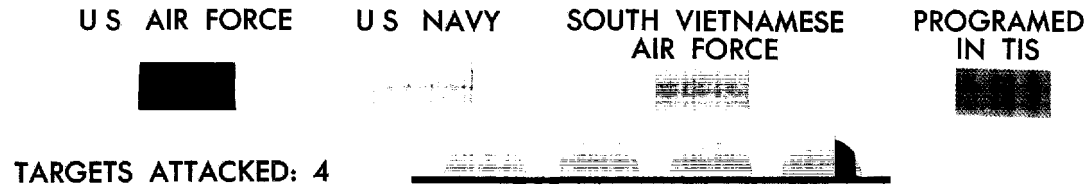
B-27 Rolling Thunder: Statistical Summary of Attacks on Bulk Petroleum Storage Facilities
2 March-24 December 1965

61378

25X1

ROLLING THUNDER

Attacks on Port Facilities and Naval Bases, 2 March-24 December 1965



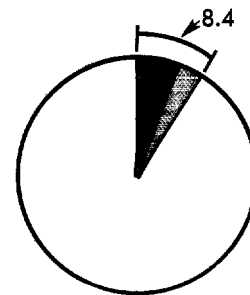
% NATIONAL CARGO HANDLING CAPACITY

PROGRAMED FOR DESTRUCTION

8.4

ACTUALLY^b DESTROYED

5.7



ORDNANCE (TONS) PROGRAMED IN TIS

ACTUAL

390

320

55

15

STRIKES:

23

21

1.4

.6

SORTIES

PROGRAMED IN TIS^a

868

STRIKE & FLAK

315

263

28

SUPPORT SORTIES

111

87

2

AIRCRAFT LOST

3

PERSONNEL LOST

3

^a UPPER LIMIT OF THE RANGE OF ORDNANCE AND SORTIES GIVEN IN THE TARGET INFORMATION SUMMARY (TIS) OF THE JOINT CHIEFS OF STAFF AS THE OPERATIONAL REQUIREMENTS FOR 70% DESTRUCTION OF THE TARGET

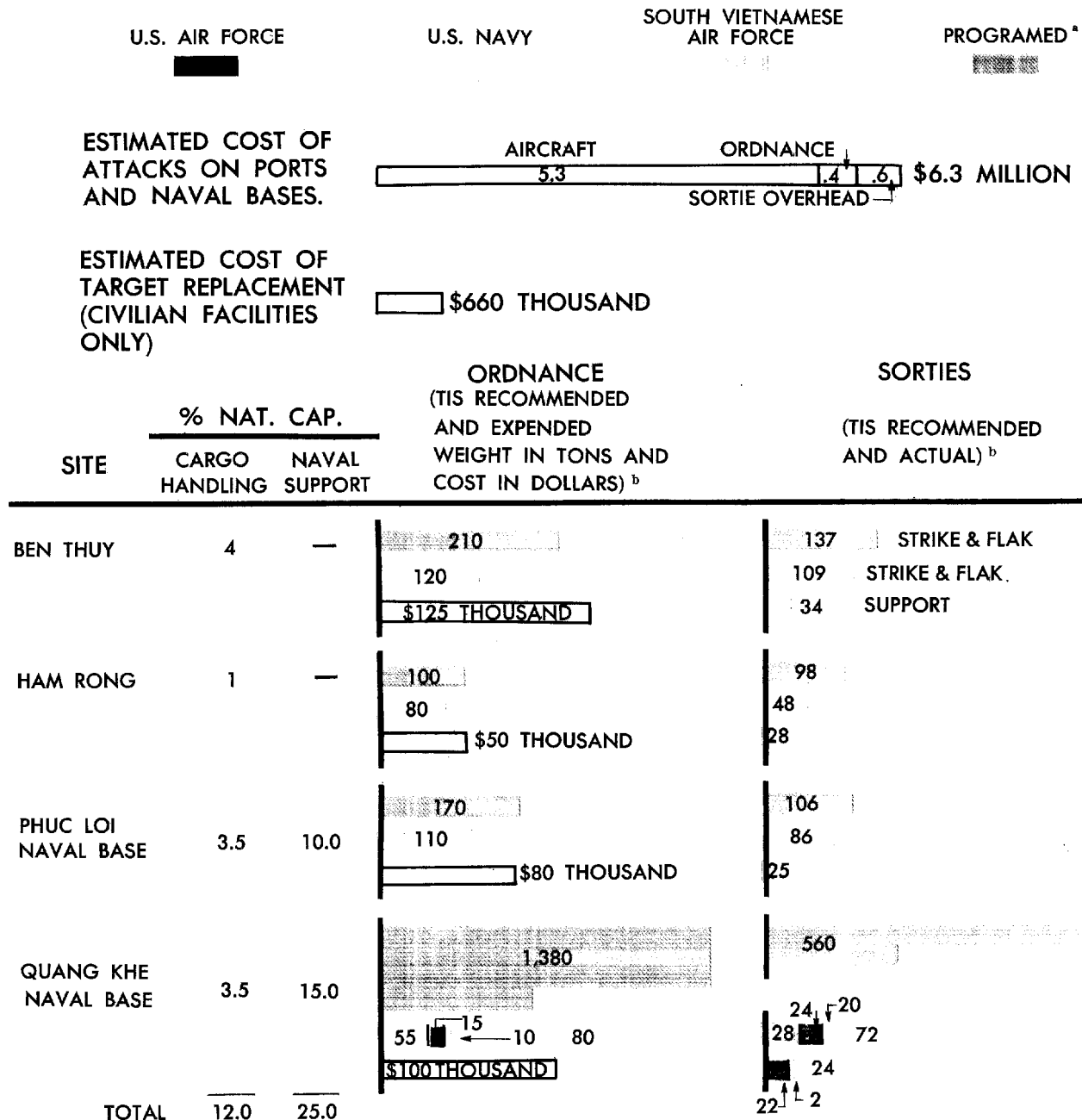
^b 15 PERCENT OF NORTH VIETNAMESE NAVAL BASE SUPPORT CAPACITY WAS DESTROYED AT THE TWO NAVAL BASES.

B-28 a Rolling Thunder: Statistical Summary of Attacks on Port Facilities and Naval Bases
2 March-24 December 1965

61379

25X1

25X1

ROLLING THUNDER**Attacks on Port Facilities and Naval Bases, 2 March-24 December 1965**

^a UPPER LIMIT OF THE RANGE OF ORDNANCE AND SORTIES GIVEN IN THE TARGET INFORMATION SUMMARY (TIS) OF THE JOINT CHIEFS OF STAFF AS THE OPERATIONAL REQUIREMENTS FOR 70% DESTRUCTION OF THE TARGET

^b 15 PERCENT OF NORTH VIETNAMESE NAVAL BASE SUPPORT CAPACITY WAS DESTROYED AT THE TWO NAVAL BASES.

Figure B-28b Rolling Thunder: Statistical Summary of Attacks on Port Facilities and Naval Bases, 2 March-24 December 1965

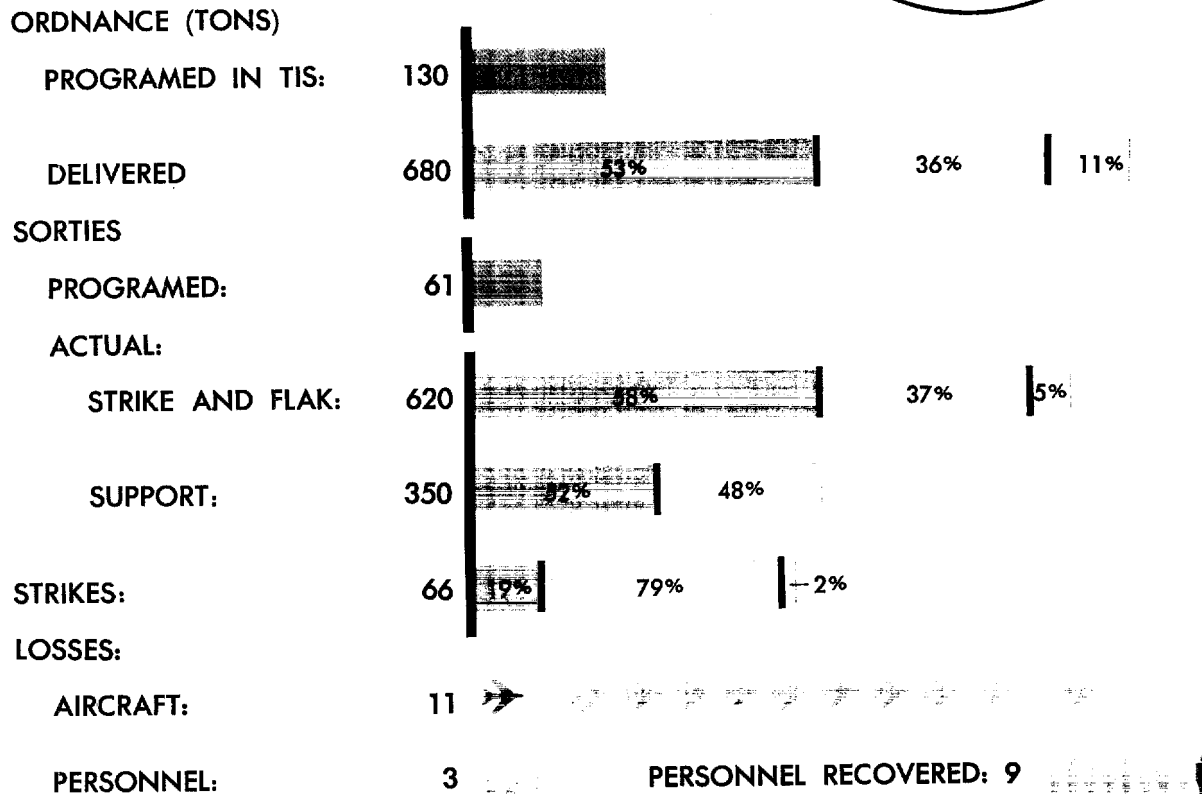
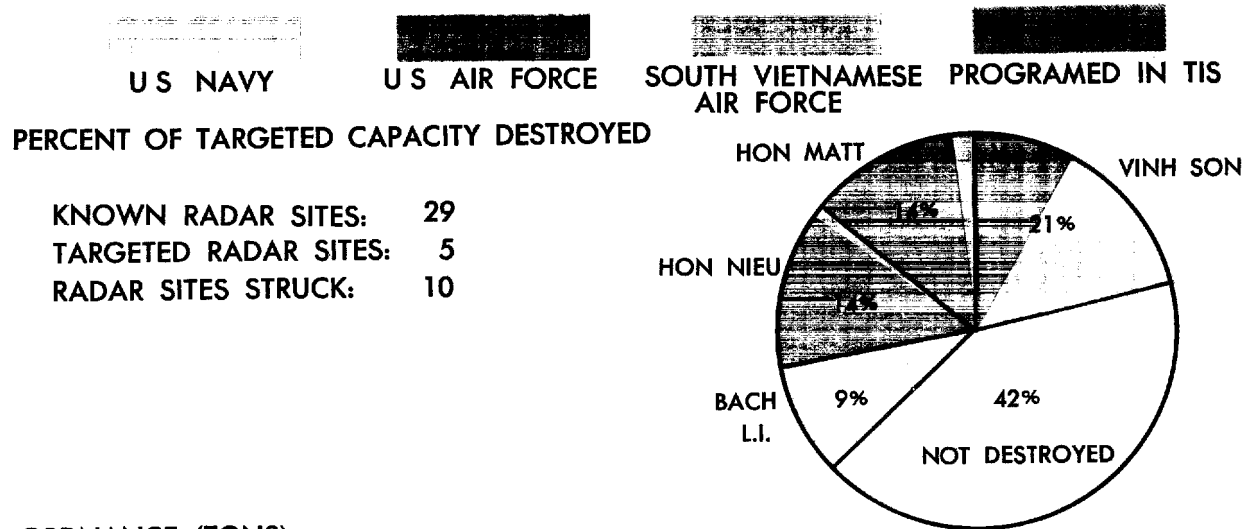
61389

25X1

25X1

ROLLING THUNDER

Attacks on Radar Installations, 2 March 1965-24 December 1965



a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

B-29 Rolling Thunder: Statistical Summary of Attacks on Radar Installations
2 March-24 December 1965

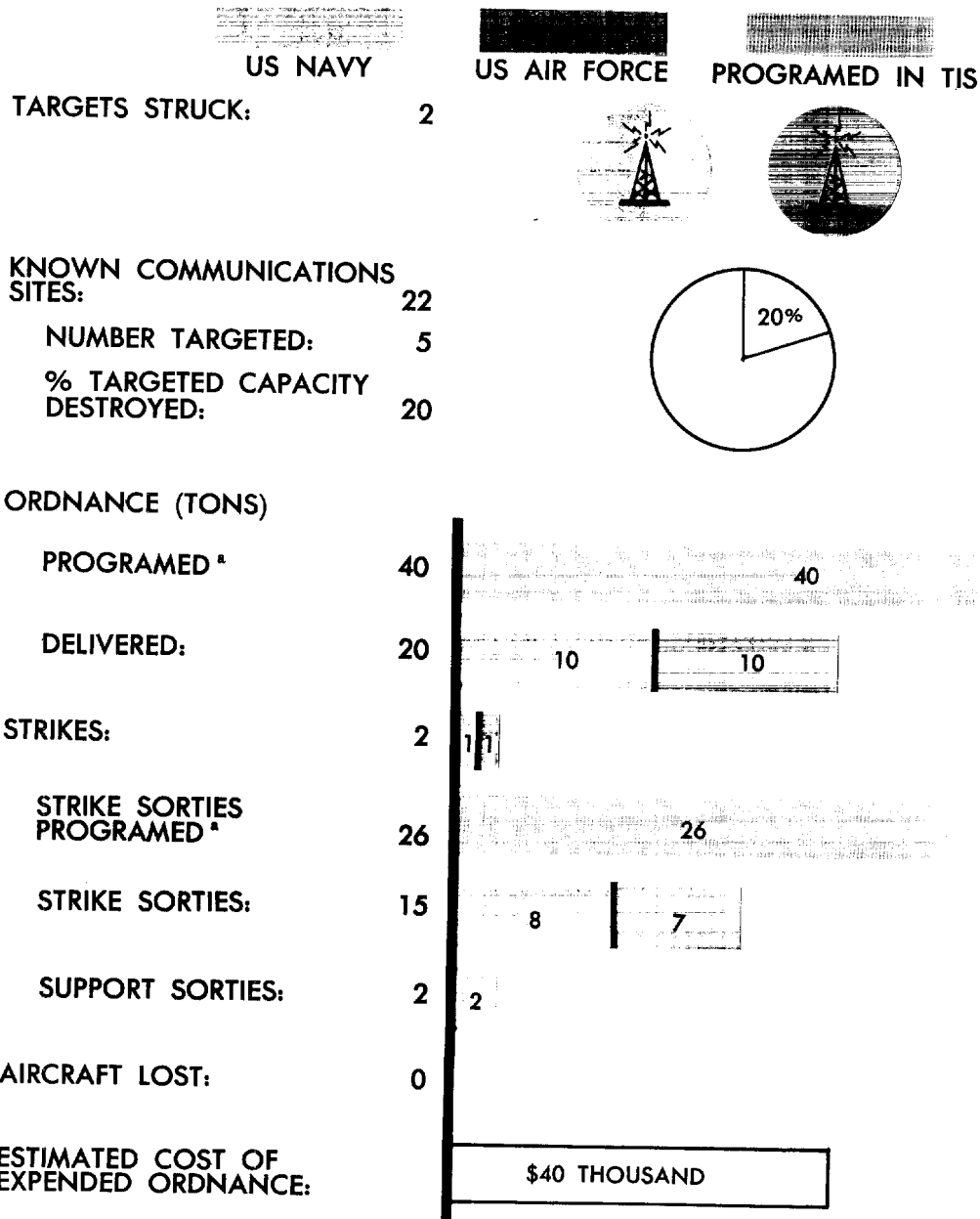
61380

25X1

ROLLING THUNDER

Attacks on Communications Facilities, 2 March-24 December 1965

25X1



* UPPER LIMIT OF THE RANGE OF ORDNANCE AND SORTIES GIVEN IN THE TARGET INFORMATION SUMMARY (TIS) OF THE JOINT CHIEFS OF STAFF AS THE OPERATIONAL REQUIREMENTS FOR 70% DESTRUCTION OF THE TARGET

B-30 Rolling Thunder: Statistical Summary of Attacks on Communications Facilities
2 March-24 December 1965

25X1

61381

25X1

ROLLING THUNDER

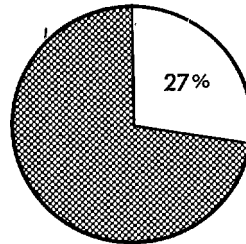
Attacks on Electric Powerplants, 2 March 1965-24 December 1965

U S AIR FORCE U S NAVY PROGRAMED IN TIS

TARGETS
ATTACKED: 6

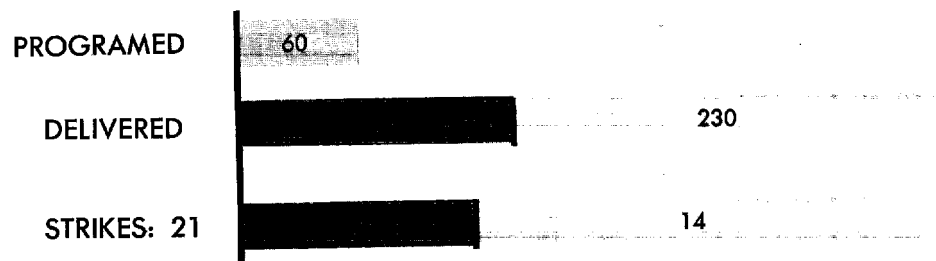
5 THERMAL 1 HYDRO

TOTAL NATIONAL CAPACITY:
175,000 KILOWATTS

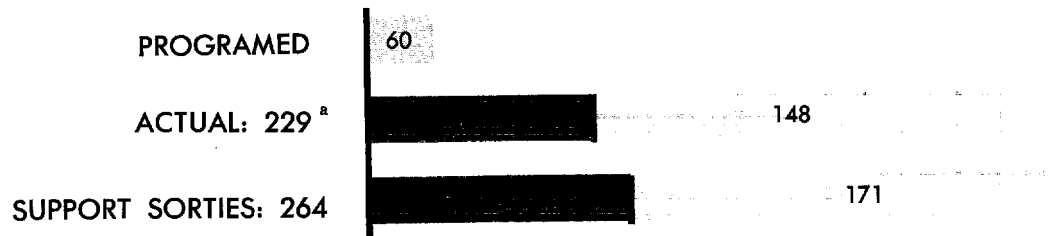


PERCENT NATIONAL CAPACITY
DESTROYED: 27

ORDNANCE: (TONS)



STRIKE SORTIES (INCLUDING
FLAK SUPPRESSION SORTIES)



STRIKE AIRCRAFT LOST: 4

PERSONNEL LOST: 3

PERSONNEL RECOVERED: 1

ESTIMATED COST OF ATTACKS ON
ELECTRIC POWER PLANTS (MILLION US\$): 6.0

ORDNANCE	AIRCRAFT	SORTIE OVERHEAD
0.7	4.4	0.9

ESTIMATED COST OF TARGET RESTORATION
(MILLION US\$): 7.8

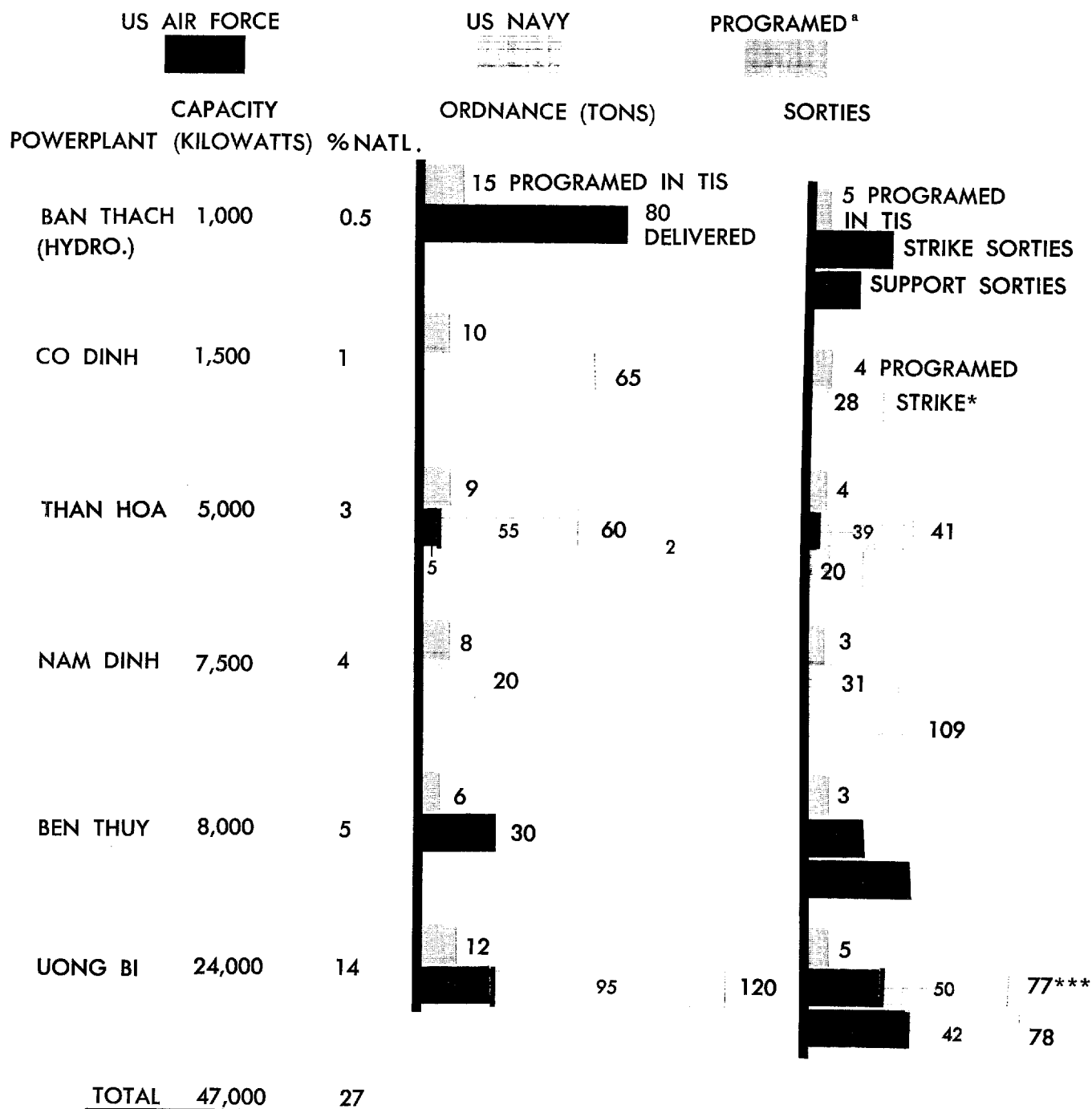
7.8

^a INCLUDES 19 AIRCRAFT THAT ALSO ATTACKED FIXED TARGETS OF OTHER TYPES ON MISSION.

B-31a Rolling Thunder: Statistical Summary of Attacks on Electric Powerplants
2 March-24 December 1965

61382

25X1

ROLLING THUNDER**Attacks on Electric Powerplants, 2 March 1965-24 December 1965**

a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

*ASTERISKS INDICATE NUMBER OF AIRCRAFT LOST.

B-31b Rolling Thunder: Statistical Summary of Attacks on Electric Powerplants
2 March-24 December 1965

25X1

ROLLING THUNDER

Attacks on Explosives Plants, 2 March 1965-24 December 1965

US AIR FORCE

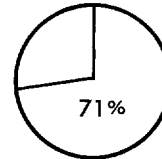
PROGRAMED IN TIS

TARGETS ATTACKED: 1



% NATIONAL CAPACITY: 100

% NATIONAL CAPACITY DESTROYED: 71



ORDNANCE (TONS)

PROGRAMED: ^a 640

DELIVERED: 90

STRIKES: 3

STRIKE SORTIES

PROGRAMED IN TIS: 416

FLOWN:
(INCLUDES FLAK
SUPPRESSION) 28

SUPPORT SORTIES: 50

STRIKE AIRCRAFT LOST: 1

PERSONNEL LOST: 0

ESTIMATED COST OF
ATTACKS ON
EXPLOSIVE PLANT

\$120,000
ORDNANCE

\$210,000
SORTIE OVERHEAD

\$330,000

ESTIMATED COST OF
TARGET REPLACEMENT

\$370,000

a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

B-32 Rolling Thunder: Statistical Summary of Attacks on Explosives Plants, 2 March-24 December 1965

61383

25X1

APPENDIX C

AN APPRAISAL OF THE EFFECTS OF THE BOMBING OF NORTH VIETNAMI. Physical Damage

The cost of reconstruction or repair of the economic and military facilities in North Vietnam which were attacked under the Rolling Thunder program is estimated at about US \$63 million. About 57 percent of the damage was inflicted on targets of an economic nature and roughly 43 percent against military targets. Strikes against assigned JCS targets (both military and economic) accounted for about 79 percent of the damage and armed reconnaissance missions for about 21 percent. Generally, most of the targets struck are located in southern North Vietnam and consequently are not of major importance either economically or militarily. The bulk of North Vietnam's important and as yet unstruck targets are located in the Hanoi-Haiphong complex. For a graphic presentation of the costs of reconstruction or repair of these economic and military facilities, see Figures C-1 through C-6. For locations of JCS targets, see the map, Figure C-7.

A. Economic1. Powerplants

North Vietnam's pre-strike electrical generating capacity is estimated at 175,000 kilowatts. About 75 percent of this total was generated by the main electric power grid which is made up of eight large interconnected powerplants serving about 90 percent of North Vietnam's industry. Attacks on North Vietnam's electric power-producing facilities started in April 1965 and extended through 22 December. In all, six powerplants were struck, only two of which -- Ben Thach and Uong Bi -- are in the main power grid. The number of attacks against the powerplants ranged from two each against the Ben Thuy and Co Dinh powerplants to six against the plant at Thanh Hoa. The final powerplant to be struck was the one at Uong Bi, which was attacked four times in December (see Table C-1).

The six power facilities struck under the Rolling Thunder program effectively lost all their capacity to generate electric power, although the physical plants sustained varying degrees of destruction. Total power-generating capacity in North Vietnam has been reduced by about 27 percent while that of the main grid has been reduced by nearly 25 percent.

In general, the damage to the powerplants is so severe that none can be repaired quickly. In most cases, repair will necessitate dismantling and reconstruction of portions of the facilities, a process

Table C-1

Electric Powerplants Attacked Under the Rolling Thunder Program

25X5

Target Number	Name	Target Capacity (Kilowatts)	Target as a Percent of National Capacity	Dates of Attack (1965)	Percent of Target Capacity Currently out of Operation	Percent of National Powerplant Capacity Currently out of Operation	Cost of Restoration (Thousand US \$)
25X1	Thanh Hoa	5,000	3	4 Apr 27 Jul 29 Jul 30 Jul 31 Jul 4 Aug	100	3	1,100
	Ben Thuy	8,000	5	4 Jun 4 Jun	100	5	1,000
	Co Dinh	1,500	1	8 Jun 10 Jun	100	1	400
	Nam Dinh	7,500	4	28 Jul 29 Jul 2 Aug 3 Aug	100	4	2,000
	Ben Thach	1,000	0.5	21 Aug 22 Aug 23 Aug	100	0.5	300
	Uong Bi	24,000	14	15 Dec 20 Dec 22 Dec 22 Dec	100	14	3,000
	Total					27 a/	7,800

25X1

a. Representing a net loss in national generating capacity of approximately 47,000 kilowatts. Total national electric power-generating capacity is 175,000 kilowatts.

almost as time consuming and costly as the original construction, and will require considerable foreign technical assistance as well as the importing of major components. At least six months will be required to restore three of the six plants to even partial operation (including the important Uong Bi facility) and from one to one and one-half years for the remaining three. Full restoration will require from one to two years and even longer for the Nam Dinh plant. Total cost of restoration is estimated to be \$7.8 million.

The financial burden, however, is only partly indicative of the effect of the attacks. In order to reconstruct the facilities destroyed, large inputs of highly skilled personnel and materials embodying advanced technology will be required, forcing North Vietnam to make substantial diversions of resources from other priority needs as well as to require still more foreign assistance.

While destruction of the power facilities thus represents a distinct economic loss to North Vietnam, it is by no means of crippling proportions. Loss of capacity at those stations outside of the principal power network has resulted in local power shortages (in some cases stoppages) in the southern part of the country and in a reduction of the power available for agricultural irrigation. On the other hand, it is likely that the destruction of the capacity at the two network stations -- Nam Dinh and Uong Bi -- has been offset by an increased utilization of existing generating capacity in other powerplants joined to the network. Thus most of the major industrial requirements for power in the Haiphong-Hanoi area are probably being met.

2. Petroleum Storage

The allied strike on the major petroleum storage depot at Vinh in August 1964, in retaliation for the Tonkin Bay incidents, was the first attack on a North Vietnamese economic target. Since then, three other petroleum storage facilities have been bombed and the Vinh facility has been restructed (see Table C-2).

Pre-strike, major bulk petroleum storage capacity is estimated at about 190,000 tons,* located at 11 principal installations and a number of small, untargeted, local-issue storage points. Additional storage installations which were under construction at the time of the initial Vinh attack have been completed, and small, dispersed installations composed of semisurface, small, horizontal tanks have also been developed. The total oil storage capacity, therefore, is estimated to have been 216,000 tons, located in 12 principal installations and at small and untargeted sites.

Damage to the four storage installations which have been bombed represents a loss of 37,000 tons, or about 17 percent of the

* Tonnages are given in metric tons.

Table C-2

Petroleum Storage Facilities Attacked Under the Rolling Thunder Program

25X5

<u>Target Number</u>	<u>Name</u>	<u>Target Capacity (Metric Tons)</u>	<u>Target as a Percent of National Capacity</u>	<u>Dates of Attack (1965)</u>	<u>Percent of Target Capacity Destroyed</u>	<u>Percent of National Storage Destroyed</u>	<u>Cost of Restoration (Thousand US \$)</u>
	Phu Van	1,000	Negl.	6 May	100	Negl.	19
	Phu Qui	10,000	5	18 May	80	4	151
	Vinh	18,000	9	a/ 24 May 26 May 11 Sep 15 Sep 6 Oct	89	7	300
	Nam Dinh	12,000	6	2 Jul 4 Jul	100	6	230
	Total					17 b/	700

a. The facility at Vinh was attacked in August 1964, prior to the Rolling Thunder program.

b. Representing a loss in national storage capacity of approximately 37,000 metric tons. Total national storage capacity is 216,000 metric tons.

C-4

total capacity known to have existed in North Vietnam.* Individually, the strikes yielded complete destruction of capacity at Nam Dinh (12,000 tons) and Phu Van (1,000 tons), 80 percent at Phu Qui (originally 10,000 tons), and 89 percent at Vinh (originally 18,000 tons).

Total usable oil storage capacity in North Vietnam is estimated to have been 179,000 tons as of January 1966. This total includes 165,000 tons at eight principal and unattacked installations, 4,000 tons of residual capacity in two of the four bombed sites, and 10,000 tons in untargeted, dispersed, small storage sites. Total supply of petroleum to North Vietnam in 1965 is estimated to have been about 175,000 tons.

To restore the tankage damaged and destroyed at these four facilities would take from two to three months and would cost nearly \$700,000. Materials for such a reconstruction would probably have to come from outside sources, presumably the USSR.

While loss of the storage facilities at Nam Dinh, Vinh, and Phu Qui has eliminated all bulk storage south of Haiphong, the economic effect has not been significant. Neither industry nor agriculture in North Vietnam is a large user of petroleum, and requirements could be met by makeshift storage and distribution procedures. In fact, it appears that North Vietnam has not chosen thus far to restore the bombed facilities but rather is dispersing petroleum supplies by the development of small storage depots elsewhere.

3. Manufacturing

Two manufacturing facilities have been bombed under the Rolling Thunder program. The Lang Chi Explosives Plant, attacked three times during July and August, is an assigned JCS target. The Nam Dinh Textile Mill, which is not an assigned target, was unintentionally damaged by a strike in late July against the Nam Dinh Thermal Powerplant, which lies adjacent to the mill (see Table C-3).

The damage sustained by both facilities is of little consequence to the economy or to North Vietnam's capacity to wage war. Although the Lang Chi plant is the only known North Vietnamese explosives producer, North Vietnam relies heavily on imports from other Communist countries. There is evidence in some recent years that Communist China has furnished virtually all the explosives required by North Vietnam. Damage to the Nam Dinh Textile Mill -- an important producer of cotton textiles -- was not extensive.

* The damage assessment includes the initial attack of the petroleum facility at Vinh, which took place prior to the Rolling Thunder program.

Table C-3

Manufacturing Facilities Attacked Under the Rolling Thunder Program

Target Number	Name	Target as a Percent of National Capacity	Dates of Attack (1965)	Percent of Target Capacity Destroyed	Percent of National Capacity Destroyed or Inactive	Cost of Restoration (Thousand US \$)
	Lang Chi Explosives Plant	100	24 Jul 7 Aug 8 Aug	71	57	370
	Nam Dinh Textile Mill	70 to 75 cotton spinning, 50 cotton weaving	28 Jul	5	3	800
	Total					<u>1,170</u>

25X5

25X1

The attacks against the Lang Chi facility have reduced its capacity by nearly three-fourths, and the cost of restoration is estimated to be about \$370,000. Restoration of the buildings damaged and destroyed could be done in a short time and the replacement of machinery would be relatively simple, although some of it might have to be imported.

Physical damage to the Nam Dinh Textile Mill is estimated to amount to a temporary loss of about 5 percent of the mill's productive capacity. The Nam Dinh mill accounts for 70 to 75 percent of North Vietnam's cotton-spinning capacity and for at least 50 percent of the cotton produced to meet its textile needs. The complete shutdown of the plant for a period of several months or longer could result in considerable shortages of textiles. Although the severe damage to the Nam Dinh Thermal Powerplant may have caused a temporary shutdown at the textile mill, it is very likely that alternate sources of power were soon made available. The cost of repair to the mill, including the replacement of damaged equipment, is estimated at \$800,000. Replacement machinery can be imported from Communist China.

4. Bridges

a. JCS-Designated Highway Targets

Thirty JCS-designated highway bridges were destroyed or damaged by 59 attacks during the Rolling Thunder program through January 1966. The majority of these bridges are located on main highway routes in southern North Vietnam. With few exceptions, highway bridges located in the Haiphong-Hanoi area have not been attacked. Most of the highway bridges targeted by the JCS were successfully attacked during the early phases of the Rolling Thunder program -- few bridges were destroyed during the latter phases of the air war.

The highway bridges destroyed or damaged range in length from 100 to 500 feet and constitute most of the large bridges located outside of the Hanoi-Haiphong area. Generally, the North Vietnamese do not appear to have made a major reconstruction effort on these bridges. Fords, ferries, and pontoon bridges are usually pressed into service after a highway bridge has been destroyed. Major reconstruction efforts are undertaken only when the rivers are too deep to ford or when traffic bottlenecks occur because of the limitations encountered in using ferries and pontoon bridges.

b. JCS-Designated Railroad Targets

Six railroad bridges on the JCS target list have been destroyed or damaged in 20 attacks on the Hanoi-Vinh, Hanoi-Lao Cai, and Hanoi-Dong Dang rail lines. The rate of repair on rail bridges has been considerably more rapid than in the case of highway bridges.

Temporary bridge restoration on the Hanoi-Lao Cai and Hanoi-Dong Dang lines has, in certain instances, been made in less than two weeks.* Restoration on the Hanoi-Vinh line has usually taken considerably longer, though actual work time is about the same.

The economic and military importance of the Hanoi-Dong Dang and the Hanoi-Lao Cai lines undoubtedly account for the rapid restoration of these rail bridges, partly by Chinese railroad construction units. Restoration of the bridges on the Hanoi-Vinh line has been slower, probably reflecting both the more limited economic and military importance of the rail line south of Hanoi. It should be noted, however, that through rail service appears to have been reestablished between Hanoi and Vinh.

c. JCS-Designated Combination Railroad/Highway Targets

Six combination bridges have been destroyed or damaged in 19 attacks on the above-mentioned rail lines. These combination bridges have received the same priority for restoration as that given to rail bridges.

d. Armed Reconnaissance Bridge Targets

Some 660 bridges have been reported as being destroyed or damaged by pilots on armed reconnaissance missions during 1965. This figure undoubtedly contains considerable double counting and inaccurate assessments of the actual damage incurred. Estimates of destruction and damage on the basis of photographic evidence show less than 30 percent of the damage claimed by pilot reports, as shown in the following tabulation:

	<u>Destroyed or Damaged</u>	
	<u>Photographic Evidence</u>	<u>Pilot Reports</u>
Railroad and combinations	30	64
Highway bridges	145	593
Total	<u>175</u>	<u>657</u>

The costs of repairing damage inflicted on 42 JCS-designated bridges are estimated at \$4 million and at \$6.5 million for the 175 bridges struck by armed reconnaissance. Although the

* This restoration time represents reconstruction observed in photography; restoration could have been achieved in a shorter period of time.

armed reconnaissance effort has destroyed or damaged far more bridges than the strikes against JCS-designated targets, the JCS-targeted bridges are the major bridge installations.

Both money and inputs of skilled labor and material required ultimately for the complete restoration of the destroyed and damaged bridges will be considerable. Even with necessary substantial foreign assistance it appears that it will take the North Vietnamese at least five years after the present conflict is over to restore the existing damage.

5. Railroad Yards

Three railroad yards were struck under the Rolling Thunder program. Of the three, only the Vinh classification yard is on the JCS target list. Neither the Yen Bai yard (on the Hanoi-Lao Cai line serving northwest North Vietnam and Yunnan Province, China) nor the Nam Dinh yard (on the Hanoi-Vinh line serving southern North Vietnam) were assigned targets. They were attacked in conjunction with strikes against targeted facilities in the surrounding areas. These three yards represent about 10 percent of the total national railroad cargo-handling capacity. Both the amount of time and the cost involved in repairing the bomb damage to the rail yards are considered to be negligible (see Table C-4).

Although the damage inflicted on the rail yards succeeded in limiting and in certain instances in stopping temporarily the through movement of traffic along the lines, the bombings have not significantly hampered the operations of the major segments of North Vietnam's rail system.

The attacks on the Nam Dinh and Vinh yards added incremental damage to the operation of the interdicted Hanoi-Vinh line. However, the level of traffic normally moving on this line is relatively small. The damage inflicted on the Yen Bai yard, coupled with bridge interdictions along the line, limited through rail service between Hanoi and Lao Cai and since July has effectively halted exports of apatite, a principal North Vietnamese export.

Most North Vietnamese rail activity is centered on the Hanoi-Dong Dang (China) and Hanoi-Haiphong rail lines. Two large railroad yards are located in the Hanoi area (Yen Vien and Hanoi) and constitute approximately 60 percent of North Vietnamese railroad cargo-handling capacity. The heart of North Vietnam's rail system lies within the sanctuary area. Most of the locomotives, rolling stock, repair shops, and rail yards are within the Hanoi-Haiphong complex.

Table C-4

Railroad Yards Attached Under the Rolling Thunder Program

25X5

<u>Target Number</u>	<u>Name</u>	<u>Dates of Attack (1965)</u>	<u>Damage</u>	<u>Cost of Restoration (Thousand US \$)</u>	
<div></div>	Vinh Classifica- tion Yard N.W.	26 May 27 May 1 Jun	Main line interdicted in four places; four sidings interdicted	70	
	Nam Dinh Yard	2 Aug 4 Aug	Damage to switching wye, rail sidings, tracks, and build- ings		
	Yen Bai Yard <u>a/</u>	11 Jul 13 Jul 14 Jul	Damage to rolling stock; lines inter- dicted in numerous places		
	Total				70

25X1

a. Hit in conjunction with strike against JCS Target No. 44, Yen Bai Ordnance Depot.

6. Maritime Ports

Six North Vietnamese ports representing 88 percent of the country's total maritime cargo-handling capacity have been selected as JCS targets. Under the Rolling Thunder program the ports of Ben Thuy and Ham Rong, serving Vinh and Thanh Hoa, respectively, have been struck. Approximately 60 percent of the cargo-handling capacity at Ben Thuy was destroyed and approximately 15 percent at Ham Rong. It is estimated that damage to the port facilities will cost about \$660,000 to restore (see Table C-5).

The impact of this damage on North Vietnam's economy is of minor proportions. Ben Thuy and Ham Rong constitute only 5 percent of the nation's maritime cargo-handling capacity. Both ports serve southern provinces that are largely rural. Consequently, neither of the damaged ports plays an important role in the economy of North Vietnam. With the exception of machinery, most repair materials can be obtained locally. Reconstruction operations are not considered to be complex and probably could be completed in a fairly short period of time.

The most important ports, located in northeastern North Vietnam, have not been subjected to attack. The Haiphong port complex represents about 50 percent of the nation's maritime cargo-handling capacity and is by far the most active port in the country, handling most import and export trade. Cam Pha and Hon Gai, which handle primarily coal exports, make up an additional 32 percent of national cargo-handling capacity. These ports, representing 82 percent of the nation's cargo-handling capacity, are the only significant deepwater ports in North Vietnam.

7. Locks

Of the 91 locks and dams known to be in North Vietnam, 8 locks have been targeted because of their significance to inland waterways, flood control, and irrigation. Only one lock -- Bich Phuong Lock No. 3 -- located in Thanh Hoa Province, was struck under the Rolling Thunder program. This lock was attacked twice in August and was heavily damaged. The water level in the Song Chu canal undoubtedly dropped as a result of the attacks, and inland water traffic in the area was probably disrupted. Repair of the damage to the lock would take about 30 days, provided that the necessary manpower and material were readily available.

Simultaneous damage to the remaining seven locks would significantly hamper North Vietnam's inland water transport system. The destruction of the Ben Thon, Van Cau, and Lu Yen Locks in the Haiphong-Hanoi area would seriously lower the water level in the canals linking Hanoi and Thai Nguyen with the seaport at Haiphong. Since a significant portion of the goods transported in the Delta region move by inland water, the disruption of this bulk-carrier

Table C-5

Maritime Ports Attacked Under the Rolling Thunder Program

							25X5
<u>Target Number</u>	<u>Name</u>	<u>Target Capacity (Short Tons of Cargo Handled per Day)</u>	<u>Target as a Percent of National Maritime Cargo-Handling Capacity</u>	<u>Dates of Attack (1965)</u>	<u>Percent of Target Capacity Destroyed</u>	<u>Percent of National Cargo-Handling Capacity Destroyed</u>	<u>Cost of Restoration (Thousand US \$)</u>
	Ben Thuy	3,130	4	5 Jun 6 Jun 8 Jun 9 Jul 10 Jul 11 Jul 17 Jul 19 Jul 21 Jul	61	2.4	470
	Ham Rong	782.5	1	14 Jul 16 Jul 18 Jul	15	0.2	190
	Total						660

route would present the North Vietnamese with considerable transportation problems. The destruction of the other four locks in Thanh Hoa and Nghe An Provinces would also present problems to canal traffic operating in the area.

8. Agriculture

Allied attacks on electric powerplants may have indirectly caused some agricultural losses in North Vietnam during 1965. The relatively good fall rice crop may have been reduced by some 30,000 tons as a result of the lack of electric power needed to operate the irrigation pumps in the southern provinces. The imputed loss is estimated to be \$3.5 million.

Attacks on the electric power network in Thanh Hoa and Nghe An Provinces in mid-1965 probably interrupted irrigation services to nearly 100,000 acres of rice land.

25X1

25X1

A shortfall of 30,000 tons of rice would have little appreciable effect on the total rice production in North Vietnam, which averages about 4.5 million tons annually. Good weather conditions in 1965 probably more than offset the potential losses of rice attributed to irrigation difficulties -- the fall rice crop in Nghe An and Thanh Hoa Provinces was apparently above normal.

9. Export Loss

The allied air effort has resulted in a decline in North Vietnam's export of apatite and cement and possibly in the export of other commodities as well. Apatite exports during the second half of 1965 ceased as a result of the continual interdiction (July through December) of the Hanoi-Lao Cai rail line, although by mid-December the North Vietnamese had succeeded in restoring through rail service on the line. The decline in cement exports during 1965 probably reflects the increased internal consumption of cement in repairing damage inflicted by allied air attacks and in the subsequent reconstruction efforts. Export losses for cement and apatite are presented in the following tabulation:

<u>Thousand US \$</u>	
Cement <u>a/</u>	<u>3,140</u>
2nd quarter	630
3rd quarter	1,050
4th quarter	1,460
Apatite	<u>2,560</u>
2nd quarter	1,030
3rd quarter	
4th quarter	1,530
Total	<u><u>5,700</u></u>

a. Some double counting in terms of restoration cost and export loss may be included.

The fluctuations in other North Vietnamese exports present contradictory patterns that cannot be related unequivocally to the conduct of the air war.

B. Military

1. Airfields

Only 11 of North Vietnam's 22 airfields are targeted and considered to have economic and military significance. Between March and October, airfields at Vinh and Dong Hoi in the south and at Dien Bien Phu and Na San in the northwest were attacked numerous times. Dong Hoi and Vinh have limited jet capability and the other two airfields are able to handle only reciprocating engine aircraft. These four airfields represent about one-fifth of North Vietnam's targeted airfield capacity. Although each of the bombed airfields has facilities left standing, the runways are heavily cratered and the fields are unable to receive air traffic. Total restoration of these airfields will probably cost about \$380,000 (see Table C-6).

The damage inflicted on the airfields has had limited secondary military and economic effects. Air transport and passenger service is virtually nonexistent in North Vietnam, and the fear of US airpower has generally kept North Vietnamese aircraft within the confines of the sanctuary area surrounding Hanoi. It appears likely that even if the airfields had not been damaged, their vulnerable locations would have limited their usefulness as operating airbases.

Table C-6

Airfields Attacked Under the Rolling Thunder Program

25X5

<u>Target Number</u>	<u>Name</u>	<u>Percent of Target Utility Destroyed</u>	<u>Target as a Percent of National Capacity</u>	<u>Percent of National Targeted Capacity Destroyed or Inactive</u>	<u>Dates of Attack a/ (1965)</u>	<u>Cost of Restoration (Thousand US \$)</u>
	Dong Hoi	53.0 (inactive)	6	6	30 Mar 6 Jun 1 Jul 17 Sep 22 Sep 23 Sep	50
	Vinh	10.0 (inactive)	6	6	8 May 30 Jun 1 Jul	43
	Na San	45.0 (inactive)	4	4	25 Jun 23 Sep 24 Oct	144
	Dien Bien Phu	94.0 (inactive)	3	3	2 Jul 8 Jul	143
	Total		<u>19</u>	<u>19</u>		<u>380</u>

a. Dates of attack indicate only assigned strikes; in certain instances more attacks have been launched against a specific target than is indicated above.

The most important airfields in North Vietnam are located in the Hanoi-Haiphong area. The Phuc Yen and Kep airfields, near Hanoi, and the Haiphong airfield all have full jet-handling capability. These three fields represent about 50 percent of the targeted airfield capacity in the country. Airfields at Hanoi/Gia Lam and Haiphong/Kien An have limited jet-handling capacity and constitute an additional 25 percent of North Vietnam's targeted airfield capacity.

2. Naval Bases

From early March to late September the naval bases at Phuc Loi and Quang Khe were attacked periodically under the Rolling Thunder program. Of the five naval bases considered to be of targeting significance, the bombed facilities represent a relatively small share -- 25 percent -- of the total support capability available to the North Vietnamese Navy. The damaged facilities normally provide berthing, logistical support, and repair facilities for coastal patrol craft operating in the waters off central and southern North Vietnam.

Bombing succeeded in reducing the utility of Phuc Loi by nearly one-half and the operational usefulness of Quang Khe by nearly four-fifths. This damage hypothetically represents a 15-percent reduction in North Vietnam's total support capability to its naval forces. Restoration costs are estimated to be \$790,000 (see Table C-7).

The impact of the damage on the North Vietnamese Navy and economy is of limited significance. With the possible exception of replacing or repairing destroyed or damaged machinery, most of the repair materials can be obtained locally. Repair operations are not considered to be complex and could be completed in a fairly short period of time. It is doubtful that the damage to the bases has seriously affected the operations of North Vietnam's small navy, which during the air war has generally operated in areas not subject to air attack. The major naval bases located at Haiphong, Port Walnut, and Hon Gai represent 75 percent of the naval support capacity and currently serve as the base of North Vietnamese naval operations.

3. Barracks

At least 45 and possibly as many as 50 of the 63 targeted barracks in North Vietnam have been attacked under the Rolling Thunder program. Two-thirds of the barracks attacked are located in the southern provinces, one-fifth in the south-central region, and the remainder in the northwestern provinces. Damage to the barracks represents a reduction of one-fifth in national housing capacity in barracks. If restoration were attempted, the total cost would be about \$16 million (see Table C-8).*

* Text continued on p. C-22.

Table C-7

Naval Bases Attacked Under the Rolling Thunder Program

							25X5
Target Number	Name	Target as a Percent of National Support Capacity of Naval Bases	Percent of Base Capacity Destroyed	Percent of National Support Capacity of Naval Bases Destroyed	Dates of Attack a/ (1965)	Cost of Restoration (Thousand US \$)	
	Quang Khe Naval Base	15.0	47.0	7	2 Mar 28 May 21 Sep 24 Sep 27 Sep 28 Sep	130	25X1
	Phuc Loi	10.0	78.0	8	20 May 12 Sep	660	
Total				15		790	

a. Dates of attack indicate only assigned strikes; in certain instances more attacks have been launched against a specific target than is indicated above.

Table C-8

Barracks Attacked Under the Rolling Thunder Program

Target Number	Name	Target Capacity (Number of Men Accommodated)	Percent of Targeted National Capacity	Dates of Attack a/ (1965)	Percent of Targeted Capacity Destroyed	Percent of National Targeted Capacity Destroyed or Inactive	Cost of Restoration (Thousand US \$)
	Dong Hoi Barracks NW	2,500	0.6	7 Feb 24 Jul 27 Jul	82	0.5	550
	Chop Le Barracks NW	1,200	0.3	8 Feb 11 Feb 7 Jun 9 Jun 10 Jun	36 (inactive)	0.3	110
	Hon Gio Military Barracks		N.A.	14 Mar	N.A.	N.A.	20
	Vu Con Barracks Supply	500	0.1	21 Mar 23 May	71 (inactive)	0.1	90
	Vinh Linh Barracks Cent. NE	1,500	0.3	4 May 5 July 22 Sep 24 Sep 27 Sep	39 (inactive)	0.3	40
	Vinh Linh Barracks NW, Xom Cho	1,200	0.3	4 May 5 Jul	87 (inactive)	0.3	260
	Xom Trang Hoa Barracks and Supply Depot	1,350	0.3	8 May	66 (inactive)	0.3	500
	Vinh Linh Barracks East, Line Cong.	1,000	0.2	9 May	90 (inactive)	0.2	225
	Hoan Lao Barracks	2,500	0.6	19 May 22 Sep 25 Sep	80 (inactive)	0.6	550
	Phu Le Barracks/ Supply Depot	1,200	0.3	21 May	48 (inactive)	0.3	200
	Quang Suoi Barracks NE	2,500	0.6	22 May 23 Jul 26 Jul 29 Jul	32 (inactive)	0.6	200
	Phu Qui Barracks/ Supply Depot	3,000	0.7	23 May 19 Jun 20 Jun 21 Jun 22 Jun	55	0.4	700
	Mu Gia Pass Barracks	600	0.1	25 May	74 (inactive)	0.1	150
	Ben Quang Barracks SW	2,100	0.5	27 May 3 Jun 28 Jun	66 (inactive)	0.5	350

a. Dates of attack indicate only assigned strikes; in certain instances more attacks have been launched against a specific target than is indicated above.

Table C-8

Barracks Attacked Under the Rolling Thunder Program
(Continued)

25X5

25X1

Target Number	Name	Target Capacity (Number of Men Accommodated)	Percent of Targeted National Capacity	Dates of Attack a/ (1965)	Percent of Targeted Capacity Destroyed	Percent of National Targeted Capacity Destroyed or Inactive	Cost of Restoration (Thousand US \$)
	Vinh, Hqs. Military Region IV, Barracks/ Supply Depot	5,000	1.1	4 Jun 6 Jun 7 Jun 8 Jun 10 Jun 7 Aug 8 Aug 9 Aug 14 Aug 16 Aug 17 Aug	43	0.5	540
	Vinh Barracks	9,000	2.0	7 Jun 9 Jun 10 Jun 30 Jul 31 Jul 1 Aug 2 Aug 5 Aug 11 Sep 12 Sep	N.A.	N.A.	800
	Ban Xom Lom Barracks	10,000	2.3	12 Jun 14 Jun 16 Jun 10 Jul 14 Jul 18 Jul 19 Jul 20 Jul 21 Jul 5 Nov	57 (inactive)	2.3	1,425
	Muong Sen Camp	400	0.1	12 Jun	72 (inactive)	0.1	70
	Yen Phu NE	4,000	1.0	12 Jun 13 Jun 14 Jun 15 Jun 7 Sep	51 (inactive)	1.0	510
	Badon Barracks	670	0.2	14 Jun 17 Jun	30 (inactive)	0.2	50
	Sam Son Barracks West	1,200	0.3	16 Jun	22	0.1	70
	Son La Army Barracks; Hq. Military Region NW	9,000	2.0	18 Jun 20 Jun 23 Jun 24 Jun 29 Jun 30 Jun 1 Jul 13 Jul 14 Jul 15 Jul 10 Aug 11 Aug	52	1.1	1,120

Table C-8

Barracks Attacked Under the Rolling Thunder Program
(Continued)

25X5

Target Number	Name	Target Capacity (Number of Men Accommodated)	Percent of Targeted National Capacity	Dates of Attack s/ (1965)	Percent of Targeted Capacity Destroyed	Percent of National Targeted Capacity Destroyed or Inactive	Cost of Restoration (Thousand US \$)
	Moc Chau Barracks	1,000	0.2	21 Jun 23 Jun 24 Jun	65 (inactive)	0.2	160
	Dong Hoi Barracks	3,000	0.7	21 Jun 7 Aug 9 Aug	77 (inactive)	0.7	575
	Thuan Chau Barracks/ Supply Depot	1,000	0.2	29 Jun 30 Jun 10 Aug 15 Aug 16 Aug	52	0.1	250
	Don Bai Dinh Military Camp	400	0.1	29 Jun	100	0.1	100
	Dien Bien Phu Barracks	10,000	2.3	2 Jul 11 Jul 15 Jul 26 Jul 28 Jul 29 Jul 8 Aug 10 Aug 11 Aug 12 Aug 13 Aug 16 Aug 17 Aug 18 Aug	52	1.2	1,300
	Thanh Hoa Barracks South	1,500	0.3	8 Jul 21 Aug	36 (inactive)	0.3	140
	Vinh Son Barracks South	3,500	0.8	14 Jul 18 Jul 19 Jul	52 (inactive)	0.8	450
	Dong Cao Thon Barracks	5,500	1.2	21 Jul 22 Jul	88 (inactive)	1.2	1,210
	Bai Thuong Barracks NE	2,300	0.6	28 Jul 31 Jul 2 Aug 5 Aug 22 Aug	56 (inactive)	0.6	400
	Vinh Barracks NNE	2,300	0.6	2 Aug 4 Aug 5 Aug	43	0.2	250
	Xom Trung Hoa Barracks	1,000	0.2	25 Aug 28 Aug 29 Aug	31	0.1	80
	Ha Tinh Barracks/ Supply Depot	900	0.2	5 Sep 6 Sep	35 (inactive)	0.2	150

Table C-8

Barracks Attacked Under the Rolling Thunder Program
(Continued)

25X5

25X1

25X5

Target Number	Name	Target Capacity (Number of Men Accommodated)	Percent of Targeted National Capacity	Dates of Attack a/ (1965)	Percent of Targeted Capacity Destroyed	Percent of National Targeted Capacity Destroyed or Inactive	Cost of Restoration (Thousand US \$)
	Vinh Barracks NW	4,000	1.0	7 Sep 8 Sep 9 Sep 10 Sep 14 Sep 15 Sep	53	0.5	550
	Xom Bang Barracks East	850	0.2	6 Sep 12 Sep 13 Sep	97 (inactive)	0.2	200
	Co Dinh Barracks NW		0.2	7 Sep 9 Sep 10 Sep 12 Sep 14 Sep 15 Sep 16 Sep	100 (inactive)	0.2	250
	Yen Khai Barracks/ Ammunition Storage	2,500	0.6	9 Sep 10 Sep 11 Sep 12 Sep 14 Sep 15 Sep	50 (inactive)	0.6	450
	Vinh Linh Barracks SW		0.1	9 Sep 10 Sep	94 (inactive)	0.1	100
	Xom Chang Barracks South		0.1	24 Sep 30 Sep	31 (inactive)	0.1	165
	Chuc A Barracks/ Support Area		0.3	6 Oct	56	0.2	250
	Phu Van Barracks SSE		0.5	24 Oct 25 Oct 26 Oct	88	0.5	440
	Quang Khe Barracks		0.2	23 Dec	N.A.	N.A.	Neg1.
	Total					<u>18</u>	<u>16,000</u>

25X1

[redacted]

Total estimated barracks capacity in North Vietnam (443,000 men) exceeds the standing requirements of the PAVN. The order-of-battle strength of the PAVN is currently estimated to be below 300,000. A distinct possibility exists, therefore, that many of the barracks, especially those in the southern provinces, were either inactive or operating at a low level of capacity at the time they were attacked. At present it appears that the North Vietnamese have not made a significant attempt to repair the damage inflicted on the barracks.

Although the long-run economic and military implications of the damage to barracks may be significant, the short-run effects seem to be considerably less formidable. If, as seems likely, strikes against many barracks succeeded only in destroying excess or unused capacity, there would appear to be little need for the North Vietnamese Army to restore these facilities in the immediate future. The destruction of numerous barracks has undoubtedly caused the PAVN inconvenience. [redacted]

25X1

[redacted] post-strike photography indicates that in most instances barracks, if occupied, were abandoned after the initial strike. Troops from the damaged barracks apparently are being quartered with civilians in nearby towns, in tents, and in other makeshift shelters in surrounding areas.

Most of North Vietnam's more important barracks are located in the Hanoi-Haiphong complex and have yet to be attacked. The military strength in this area far exceeds that in the outlying areas already struck by US aircraft.

4. Supply Depots

Eighteen of North Vietnam's supply and ordnance depots are targeted under the Rolling Thunder program; these facilities represent one-third of the known national storage capacity. The depots struck constitute about 5 percent of national capacity, and the actual storage area destroyed is even less. Except for the Vinh Supply Depot (serving Military Region IV) and the Yen Bai Ordnance Depot (serving the Hanoi area), the depots struck are of relatively minor importance to the PAVN and are located in the southern provinces of North Vietnam (see Table C-9).

The cost of restoring these facilities is estimated to be about \$3 million. These depots could be put back into limited operation within a few days by utilizing local materials and labor and

25X1

[redacted]

Table C-9

Supply Depots Attacked Under the Rolling Thunder Program a/

Target Number	Name	Target Capacity (Square Feet)	Percent of National Capacity	Dates of Attack <u>b/</u> (1965)	Percent of Target Capacity Destroyed	Percent of National Capacity Destroyed or Inactive	Cost of Restoration (Thousand US \$)
	Phu Van SE	55,440	0.5	19 Mar 26 May	86 (inactive)	0.5	372
	Vinh Son	84,480	0.8	19 Mar 20 Jun 22 Jun 24 Jun	47	0.4	144
	Thien Linh Dong South	124,080	1.2	30 Apr 13 Aug	58 (inactive)	1.2	495
	Dong Thanh Warehouse Area South	68,640	0.6	8 May 22 Jun	71 (inactive)	0.6	492
	Vinh Loc	50,000	0.5	20 Aug	79 (inactive)	0.5	236
	Dong Thanh Warehouse West	54,000	0.5	17 Aug 18 Aug 18 Nov	38	0.2	386
	Phu Duc	30,000	0.3	26 Aug	100	0.3	N.A.
Total						4	3,000 <u>c/</u>

a. See also the following targets listed in Table C-8 which also have some supply/storage capacity:

JCS Number	Name	JCS Number	Name
	Son La Army Barracks		Vinh, Headquarters Military Region IV, Army Barracks
	Vu Con Army Barracks		Phu Qui Army Barracks
	Phu Le Army Barracks		Thuan Chau Barracks
	Ha Tinh Army Barracks		Chuc A Army Barracks
	Xom Trung Hoa Army Barracks		

b. Dates of attack indicate only assigned strikes; in certain instances more attacks have been launched against a specific target than is indicated above.
c. Including an estimated cost of \$874,500 for restoration of the supply/storage depots within barracks. See footnote a.

into full operation within weeks if replacement supplies were forthcoming. In most cases, adjacent civilian buildings in the depot areas can be used for emergency storage. The largest supply depots have yet to be attacked. These include the Hanoi Supply Depot South at Quin Loi, the Hanoi Supply Depot North at Tay Ho, the Thai Nguyen Supply Depot (believed to be the largest supply depot in North Vietnam), and the Thuan Chau Barracks and Supply Depot.

5. Ammunition Depots

Thirteen ammunition depots have been struck during the Rolling Thunder program. Almost two-thirds of North Vietnam's ammunition storage capacity is estimated to have been destroyed, damaged, or deactivated as a result of allied airstrikes. The cost of restoring these facilities is estimated to be \$4.5 million (see Table C-10). These figures, however, must be qualified. Most of the destroyed capacity has been located in the southern, central, and western areas of North Vietnam. It is also difficult to tell at what level of capacity these depots were being utilized before the airstrikes began. Although there is no indication that any ammunition depot resumed activity after being hit, it is estimated that a limited reactivation of the depots, using tents, could be accomplished in 10 days.

Of the ammunition depots attacked, Bac Can, Tai Xouan, Lang Het, Yen Son, and Yen Bai probably play a role in the ammunition supply arrangements between China and North Vietnam. The other depots are important for regional support of North Vietnamese troops and for supplying the Viet Cong and PAVN units in Laos and South Vietnam. The destruction of these depots probably has caused temporary delays but has not caused a cessation in the movement of ammunition.

Several ammunition depots not yet struck by allied forces seem to be fundamental to the overall supply network between China and North Vietnam. Their loss in the short run would be significant in hampering North Vietnam's military efforts in the south. For example, the destruction of the Hon Gai depot which serves the 320th Division in the Haiphong area would reduce ammunition supplies to Haiphong but might also eliminate secure storage for new stocks coming in from China. The Cam By depot, which supports the Hanoi-Haiphong complex, also serves depots to the south. Its destruction would delay the movement of supplies going south and would also deny additional storage for ammunition imported from China. The Haiphong depot is known to serve as a major ammunition storage area for ground forces in the Haiphong area and may also be used to store ammunition headed south. The Phu Lang Thuong depot mainly provides storage space for ammunition imported from China. The destruction of the above-mentioned facilities would initially limit the movement of ammunition from China to North Vietnam and would hinder the internal distribution of ammunition supplies.

Table C-10

Ammunition Depots Attacked Under the Rolling Thunder Program a/*

Target Number	Name	Target Capacity (Metric Tons)	Percent of National Capacity	Dates of Attack b/ (1965)	Percent of Targeted Capacity Destroyed	Percent of National Capacity Destroyed or Inactive	Cost of Restoration (Thousand US \$)
C-25	Xom Bang	5,000	4	2 Mar	75.0 (inactive)	4	260
	Phu Qui	9,000	8	15 Mar 30 Apr 22 May 4 Jun	62.0 (inactive)	8	300
	Phu Van	3,800	3	19 Mar 5 May 6 May	71 (inactive)	3	150
	Xom Rung	4,120	4	4 May 31 Jul	13 (inactive)	4	30
	Hoai An	8,236	7	30 May 31 May 1 Jun	61 (inactive)	7	240
	Dan Nuoc Chiev	11,900	11	20 Jun 22 Jun 24 Jun 6 Jul 23 Jul 6 Aug 8 Aug 11 Aug 18 Sep	48 (inactive)	11	530
	Qui Hau	11,500	10	25 Jun 26 Jun 27 Jun 3 Jul 4 Jul 8 Jul	32 (inactive)	10	240
	Ban Phiang Hay	1,500	1	25 Jun 30 Jun	50 (inactive)	1	50
	Yen Son	10,000	9	9 Jul 10 Jul 11 Jul 12 Jul 20 Jul 25 Sep 26 Sep	58 (inactive)	9	960

* Footnotes follow on p. C-26.

Table C-10

Ammunition Depots Attacked Under the Rolling Thunder Program a/
(Continued)

Target Number	Name	Target Capacity (Metric Tons)	Percent of National Capacity	Dates of Attack <u>b/</u> (1965)	Percent of Targeted Capacity Destroyed	Percent of National Capacity Destroyed or Inactive	Cost of Restoration (Thousand US \$)
[REDACTED]	Yen Bai		3	9 Jul 10 Jul 11 Jul 12 Jul 13 Jul 14 Jul 17 Jul	55	2	1,190
	Tai Xouan	7,700	7	24 Jul 18 Sep 21 Sep 23 Sep 26 Sep	32	2	330
	Bac Can	2,000	2	5 Sep 8 Sep 10 Sep 12 Sep 14 Sep 15 Sep	75 (inactive)	2	200
	Lang Het	6,750	6	5 Oct	4	0.2	20
	Total					6.2	4,500

b. Dates of attack indicate only assigned strikes; in certain instances more attacks have been launched against a specific target than is indicated above.

6. SAM Sites

From July through December, 27 of North Vietnam's 64 known surface-to-air (SAM) sites were struck.* It is believed that no more than 15 to 20 of these sites were operational at any one time. Most of the SAM sites are located within the greater Haiphong-Hanoi area and the remaining sites guard segments of the Hanoi-Vinh, Hanoi-Lao Cai and Hanoi-Dong Dang rail lines outside the delta region.

Sixteen of the 27 sites attacked were unoccupied or were staffed with dummy missiles. Eleven of the sites attacked contained SAM's and sustained considerable damage, as shown in the following tabulation:

	<u>Destroyed</u>	<u>Damaged</u>
SAM's	5	1
Sites	0	17
Radar vans	1	2
Missile transporters	10	2
Launchers	4	1
Support buildings	17	30

Damage to SAM facilities in North Vietnam is estimated to be at least \$630,000.** Initially, SAM installations were designated as JCS targets only, but authority was given later for attacks by armed reconnaissance under strictly limited conditions. Approximately 200 missiles were fired in 1965 against allied targets. A total of 10 planes and 7 drones were lost to missiles during the Rolling Thunder program through 24 December.

7. Communications

North Vietnam has 35 large high-frequency (HF) radio stations, only 5 of which are targeted under the Rolling Thunder program. Two of the targeted facilities, Chanh Hoa and Muong Sen, were struck on 19 May and 12 June 1965, respectively. Estimates of damage range from 20 percent physical destruction at Chanh Hoa to 80 percent at Muong Sen. The cost of restoring both facilities is estimated to be \$50,000.

* Since the end of the year the SAM system has been extended to include over 90 sites.

** This total includes cost estimates for SAM's, radar vans, missile transporters, and launchers damaged or destroyed. It is based on an average, reflecting the probability that neither the best nor the newest equipment has been furnished to North Vietnam. It has not been possible to assign a dollar value to the damage of launch sites or support buildings.

Although open wirelines have not been explicitly targeted for destruction, numerous breaks have occurred as a result of the bombing of railroads, bridges, and roads. When such breaks occur, the normal pattern of communications is shifted to HF radio. Thus far, breaks in the wirelines have been of little consequence when viewed against the total available telecommunications resources in North Vietnam. The cost of collateral damage to the communications system is estimated to be an additional \$20,000. Most of the damage, both direct and collateral, has been inflicted in the southern portion of North Vietnam.

The most important fixed radio facilities in North Vietnam are located in the greater Hanoi area. Among these facilities are the radiobroadcast complex at Me Tri, the HF international transmitting center at Dia Mo, the international receiving station at Son Dong, and about 30 other sizable HF radio stations in the greater Hanoi area. These facilities serve the Armed Forces High Command, the Central Executive Committee of the Lao Dong Party, and various economic components within North Vietnam. Important wireline routes within the delta region radiate out from Hanoi to Haiphong and Thanh Hoa and to the Chinese and Laotian borders.

Destruction of broadcast facilities within the Hanoi area would severely curtail national broadcast services. The subsequent destruction of the international HF stations would temporarily eliminate the only direct communications link with the outside world. However, by making use of relay stations, international communications could, with some inconvenience, be restored in relatively short order. Irrespective of damage to fixed installations, a large number of small radio stations would remain. These small HF stations would probably prove to be adequate to accommodate essential political and military needs.

8. Radar

There were three radars destroyed and six damaged in Rolling Thunder operations through 24 December. One radar was struck as a target of opportunity under the armed reconnaissance program; all the rest were associated with the JCS target program either as primary targets or as a part of a SAM site. The estimated value of the radars destroyed is as follows:

<u>Number</u>	<u>Type</u>	<u>Thousand US \$</u>
2	SCR-270 early warning	150
1	TRACKDISH fire control	245
Total		<u>395</u>

The radars damaged are believed to be of the types listed below:

<u>Number</u>	<u>Type</u>	<u>Thousand US \$</u>
1	KNIFEREST B early warning	75
2	CROSS SLOT early warning	150
1	SCR-270 early warning	75
1	SPOONREST A early warning	75
1	FLAT FACE early warning/target acquisition	260
Total		<u>635</u>

The bombing of radar installations in North Vietnam has not been of crucial significance to the country thus far. The Soviet-manufactured TRACKDISH radar has already been replaced by a KNIFEREST B of Chinese manufacture, and the others can readily be replaced by the Chinese. The Chinese are specifically manufacturing for the North Vietnamese at this time and are drawing upon a major capability in this field. Overall early warning capabilities in North Vietnam have not been affected by the Rolling Thunder activities -- there are more radars in the country now than at the outset of the program.

C. Armed Reconnaissance

During 1965 the armed reconnaissance phase of the Rolling Thunder program was primarily directed against transport vehicles, small bridges, occasional assigned fixed targets, ferry facilities, and small pre-briefed targets in selected regions of North Vietnam. Some 28,000 armed reconnaissance sorties inflicted about \$13.4 million worth of damage (see Table C-11).

Beginning in late March, allied aircraft were authorized, on a limited basis, to attack locomotives, railroad rolling stock, vehicles, and hostile North Vietnamese craft on selected routes below the 20th parallel. As the program expanded, greater areas of North Vietnam were opened for attack and more sorties and targets were authorized for armed reconnaissance missions. At the peak of the air war, roughly two-thirds of North Vietnam (excluding the Hanoi-Haiphong area, the northeastern provinces, and a 30-mile buffer zone along the North Vietnam-China border) was open to armed reconnaissance attack.

Damage to transport equipment accounted for \$6 million, bridges \$6.5 million,* miscellaneous buildings \$280,000, and military-associated targets about \$670,000 (see Table C-12). Most of the damage was inflicted in the southern provinces.

* For a further discussion of bridges destroyed or damaged by armed reconnaissance, see section A, 4, above.

Table C-11

Cost of Damage Inflicted by Armed Reconnaissance Sorties a/

<u>1965</u>	<u>Total Cost of Damage (Thousand US \$)</u>	<u>Number of Armed Reconnaissance Sorties</u>	<u>Cost of Damage per Sortie (U25X1)</u>
April	555	1,200	462
May	565	1,237	457
June	1,002	1,386	723
July	900	1,732	520
August	620	4,221	147
September	642	4,594	140
October	763	5,458	140
November	1,285	5,108	252
December	625	2,996	209
Total	<u>6,957</u>	<u>27,932</u>	

a. Excluding damage to bridges of \$619,000 on armed reconnaissance sorties.

Table C-12

Inventory of Damage by Armed Reconnaissance Sorties a/

	<u>Destroyed</u>	<u>Damaged</u>
Transport equipment	<u>1,176</u>	<u>1,916</u>
Locomotives	6	6
Rail cars	227	592
Trucks	318	487
Vehicles	165	78
Ferry boats	53	56
Barges	263	487
Lighters and junks	144	210
Bridges/ferry landings	<u>175</u>	<u>557</u>
Road bridges	161	432
Railroad and combination bridges	14	50
Ferry facilities	0	75
Small pre-briefed targets	<u>1,911</u>	<u>2,625</u>
Barracks	93	137
Supply warehouses	71	105
Miscellaneous buildings	1,673	2,024
Radar and communications sites	9	133
Truck parks	3	138
Antiaircraft sites	62	88

a. The total estimated cost of damage is \$13,450,000.

II. Civilian and Military Casualties

A. General Considerations

The sources used to estimate civilian and military casualties are discussed in detail in Section C, below. The specific methodologies used in arriving at these estimates are discussed in the following paragraphs. In general the estimates of civilian casualties are based on methodologies previously adopted by CIA. The estimates of military casualties have been provided by the Defense Intelligence Agency and have been accepted as presented subject to an adjustment of plus or minus 10 percent to allow for the probable bias inherent in pilot strike reports.

From early spring of 1965, when the governments of the United States and South Vietnam launched the Rolling Thunder program,* through 24 December, when a temporary halt in the bombing was ordered, North Vietnamese casualties -- both civilian and military -- are estimated to have reached a total of 11,700 to 14,800 killed and wounded. This estimate contrasts with a claim reportedly made last fall by Hanoi officials that total casualties had reached the 75,000 mark and with the most reliable evidence available

25X1

The Rolling Thunder program has been specifically carried out with the view of avoiding civilian casualties where at all possible. It is estimated that roughly an equal number of civilian and military personnel have been killed or wounded during the course of the program, although military casualties slightly predominate in the ratio.** Strikes against the JCS-designated fixed targets, which are predominantly military, did not produce as high a ratio of civilian casualties as did the armed reconnaissance program. Bombardment of fixed targets resulted in a ratio of about two-thirds military to one-third civilian casualties. The armed reconnaissance missions, however, which were primarily directed against targets of opportunity -- both economic and military within certain prescribed areas -- and which comprised a larger share of the total Rolling Thunder sorties flown, resulted in a preponderance of civilian casualties -- estimated to be about 58 percent of the total casualties from armed reconnaissance. The civilians subjected to armed reconnaissance attacks are for the most part directly engaged in transport, construction, and repair activities directly related to the North Vietnamese war effort.

* Casualty estimates in this report reflect intelligence information available on all Rolling Thunder missions as well as the three missions of 7, 8, and 11 February which took place just prior to the inception of the Rolling Thunder program.

** Numerical data on casualties are presented in the following sections.

[redacted]

To illustrate further, bombing activities against fixed targets had tapered off considerably in the final two months covered by this report -- November and December 1965 -- and were in all but six cases directed toward the restriking of targets that had been covered by earlier missions. Furthermore, there were no targets struck in major urban areas. Under these conditions, bombing of fixed targets in November and December added only about 1 percent or less to the total of civilian casualties under the Rolling Thunder program. In other words, virtually all civilian casualties from strikes on fixed targets occurred in the first four-fifths of the timespan covered by the program. By way of contrast, armed reconnaissance during November and December added about 36 percent to total civilian casualties for this type of target. In other words, approximately one-fourth of all civilian casualties resulting from armed reconnaissance occurred in the final one-fifth of the period being studied.

Similar comparisons made for military casualties during November and December bear out these same general tendencies. Strikes on fixed targets during the two-month period added only a little over 1 percent to the total military casualties for this type of mission -- reflecting the fact that fewer targets were bombed and that they were often in an abandoned state, having been struck before. The increase in military casualties from armed reconnaissance for the final two-month period was also significant, amounting to about 45 percent.

B. Intelligence Sources for Estimating Casualties

The number of casualties from allied airstrikes in North Vietnam cannot be estimated with any precision. Sources available for such estimations range all the way from the self-serving -- and inflated -- North Vietnamese propaganda claims [redacted]

25X1

Although the United States adopted self-imposed restrictions on its air offensive against North Vietnam in order to minimize civilian casualties, it is to North Vietnam's interest to assert otherwise. Thus its propaganda media give the impression that the air offensive is a vicious and unrestrained assault on the civilian population, hospitals, schools, and other nonmilitary objectives. While there have been few North Vietnamese official statements giving precise casualty figures for specific incidents, the North Vietnamese press and radiobroadcasts and formal protests by the North Vietnamese Army to the International Control Commission imply that casualties are inordinately high. In September, Egyptian journalists were told by Hanoi officials that total casualties -- presumably both military and civilian -- were 75,000. This figure was said to include 40,000 killed and 35,000 wounded.

25X1

Although a large volume of post-strike photography is available, only a relatively small sample has been used for casualty analysis, and that mainly to determine the nature of the targeted area before attack and for post-attack assessment. Actual casualties are seldom, if ever, visible in photography.

Finally, documented German experience with Allied bombing during World War II (covering the year 1943) averaging one wounded for each eight buildings severely damaged or destroyed and one killed for each 25 buildings severely damaged or destroyed has provided a useful assessment guideline. These data show the effectiveness of even improvised shelters.

25X1

D. Estimates of Casualties from Attacks on Fixed Targets

It is estimated that strikes against fixed targets, including armed reconnaissance strikes against JCS targets, resulted in 1,700 to 2,400 civilian casualties during the period 7 February to 24 December 1965. Of these, approximately 5 to 10 percent resulted from strikes against targets located in urban areas. For the same period, it is estimated that military casualties have been within the range of 3,800 to 4,700. Probably not more than 55 military casualties and 30 civilian casualties occurred in the last two months of the program prior to the Christmas cessation, reflecting the shift in emphasis to armed reconnaissance and the fact that many fixed targets struck during that period were abandoned. Furthermore, none of the targets struck during November-December was near heavily populated areas (see the tabulation in E, below).

About 470 strikes were made against 157 fixed targets in a little more than 100 localities. Approximately three-quarters of the strikes were made against targets in 55 urban areas, which ranged in size from Nam Dinh with a population of 90,000 to Ha Tinh, 5,000. The remaining strikes were made against nearly 65 targets in about 45 rural areas. About 10 targets were located in uninhabited areas for which no civilian casualties could be expected. Of the total, about one-fourth were economic targets located in urban areas.

During the last two months covered by this report, all targets struck -- 16 in number -- were considered to be located in rural areas, although two, the Uong Bi thermal powerplant and the Hanoi SAM support facility, are associated with urban areas -- though not geographically within the boundaries of the cities.

E. Estimates of Casualties from Armed Reconnaissance Missions

Since the inception of the armed reconnaissance strikes through 24 December, approximately 17,000 sorties were flown against trucks, boats, barracks, and lines-of-communication targets such as bridges,

railroads, and ferry facilities. Civilian casualties from this activity are estimated to range between 3,500 and 4,500 killed or wounded, whereas military casualties are numbered at 2,600 to 3,200. It is of interest that, although civilian casualties resulting from strikes on fixed targets have been a negligible factor in the total during the last two months, as shown in the tabulation below,* the number of killed or wounded from armed reconnaissance is relatively high, reflecting the increase in this type of activity. There was an estimated monthly total of 325 to 410 civilian casualties from armed reconnaissance through 28 October and some 450 to 600 casualties per month during the final two months covered by this report. Similarly there were 225 to 275 military casualties through October and 400 to 500 per month in the November-December period.

<u>Type of Casualty</u>	<u>Number</u>	
	<u>February-October</u>	<u>November-December</u>
Fixed targets		
Military	3,800 to 4,600	55
Civilian	1,700 to 2,400	30
Armed reconnaissance		
Military	1,800 to 2,200	800 to 1,000
Civilian	2,600 to 3,300	900 to 1,200

F. Estimated Total Casualties

The estimated total casualties resulting both from airstrikes against fixed targets and from armed reconnaissance missions is in the range of 11,700 to 14,800 persons, probably divided about equally between killed and wounded. Of these, between 5,200 and 6,900 represent civilian casualties. This estimate cannot be endorsed as one of precision or finality, however, even though it seems reasonably consistent with the information available.

The impact of some 3,000 civilian deaths out of the total number of civilian casualties cannot be great in the total picture of life in North Vietnam, where some 350,000 persons probably died in 1965 alone. Even the accidental death rate in North Vietnam overshadows the civilian casualty losses. At the rate of 3 to 5 percent of all deaths, accidents probably accounted for from 10,500 to 17,500 deaths in 1965. Relating these casualties to those inflicted by the Viet Cong on the civilian population of South Vietnam, it is observed that 1,870 South Vietnamese

* Because of rounding, the data shown in the tabulation do not necessarily agree with data given elsewhere in this report.

civilians were killed during 1965 and some additional 12,700 were kidnapped with unknown fate. The importance of the military casualties is likewise difficult to measure except in relative terms. The approximately 6,500 to 7,900 casualties represent only a small percentage of the estimated total North Vietnamese armed force of 265,000 troops and of the military casualties of the South Vietnamese armed forces during 1965 of approximately 34,000 killed and wounded.

III. North Vietnamese Countermeasures

A. Reconstruction and Repair

From the beginning of bombing attacks in February 1965, the North Vietnamese and the Chinese Communists have demonstrated a remarkable ability to restore and rebuild damaged or destroyed bridges, to improvise substitute stream crossings, and otherwise to maintain the transportation routes (see Table C-13). Despite shortages of technical and engineering manpower, administrative inefficiencies, and shortages of some types of construction materials and equipment, they have been able both to restore most of the damaged transportation routes and to improve and extend their supply net. Their pattern of engineering operations and techniques closely parallels that used by the Communist forces during the Korean War and demonstrates a phenomenal speed in replacing or repairing destroyed and damaged bridges, as shown in the following tabulation:

<u>Type of Reconstruction</u>	<u>Length</u>	<u>Average Work Time (Hours)</u>
Railroad bridges	60 to 90 feet	48 to 72
Highway bridges	20-foot spans	20 to 24
Approaches (earth)	50 to 100 feet	4 to 6
Bypasses	per mile	20 to 30
Underwater crossings (ford)	per 100 feet	8 to 10

Simplicity of construction, improvisation, and mass use of labor make it possible to surmount quickly the inconveniences created by the bombing. Available intelligence data indicate that bomb damage to supply routes has neither stopped nor curtailed the flow of military supplies, in part because current military logistics needs are not taxing the existing system. Moreover, Communist potential for recuperability, in terms of the means for restoration and repair, maintenance, and construction of new supply routes could be at least doubled and probably tripled.

On the other hand, recuperability from damage suffered by electric powerplants has been quite slow because of the shortage of technicians and the nonavailability of spare parts. Some machinery could be put back into operation by cannibalizing other damaged equipment for needed replacement parts. In most cases, however, it will be necessary to import both parts and new replacement equipment. Shortages of electric power probably have been partly compensated for by strict rationing regulations and the introduction of small portable generating units, by the spreading out of work shifts, and by more intensive utilization of existing generating capacity. It is believed that none of the powerplants damaged by airstrikes has yet been put back into service. Petroleum (POL) bulk storage installations which have been damaged have been

Table C-13

Estimated North Vietnamese Imports by Land and the Increase in Imports
Resulting from the Rolling Thunder Program
1965

	Total Imports (Metric Tons)	Volume (Metric Tons)	Increase in Imports Resulting from Bombing			25X1 Remarks
			Number and Type	Source		
Total	<u>310,000</u>	<u>110,000</u>				
Military	<u>100,000</u>	<u>90,000</u>				Including (other than that noted below) large shipments of various types of artillery, tanks, mortars, small arms, other weapons, and ammunition.
Of which:						
SAM equipment	9,600 to 14,600	9,600 to 14,600	15 to 20 active sites	USSR		Including fire battalions and support battalions.
AAA equipment	4,600 to 5,600	4,600 to 5,600	1,000 to 1,200 weapons	USSR and China		
Aircraft	420	420	8 Il-28 11 MIG-21 24 to 25 MIG- 15/17 44 MIG-15/17	USSR USSR USSR China		Including 36 MIG-15/17's flown in from China in 1964 after the Gulf of Tonkin incident, 8 MIG-15/17's flown in from China in 1965, and 8 Il-28's flown in from the USSR in 1965. MIG aircraft from the USSR were shipped by rail in crates.
Radar	420	420	67 a/	70 percent from China 30 percent from the USSR		Probably as important as the increased quantity of radars is the shift to more sophisticated equipment. Some older types of radars have actually been retired.
Economic	<u>210,000</u>	<u>20,000</u>				Including (other than that noted below) increased shipments primarily of con- struction supplies such as bridge steel, rails, and asphalt; boats and barges; bicycles and parts; truck parts; medical supplies; and probably some increased shipments of food, textiles, and radio equipment.
Of which:						
Coke and coking coal	160,000	0		China		Although coal imports increased in 1965, the increase resulted from the opening of the second blast furnace at the Thai Nguyen Iron and Steel Complex, not from the bombing.

Table C-13
(Continued)

	Total Imports (Metric Tons)	Volume (Metric Tons)	Increase in Imports Resulting from Bombing		
			Number and Type	Source	Remarks
Economic (Continued)					
Petroleum products	6,800 <u>b</u> /	1,700	Jet fuel and some aviation gas	USSR	Jets were first brought in after the Gulf of Tonkin incident. Imports of aviation gas probably also increased.
Trucks	5,500 <u>b</u> /	5,400	1,330 cargo trucks; 8 crane trucks	China China	Probably almost all trucks imported from China were a result of the bomb- ing.
Railroad rolling stock	1,000 <u>b</u> /	900	4 locomotives; 64 freight cars	China	Including 2 locomotives sent from Rumania by sea.

a. Excluding radars included as part of the SAM equipment.
b. Reported shipments. The actual total probably is larger.

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neither repaired nor replaced. It is possible that the Communists have no intention of restoring the damaged POL storage facilities and have chosen to protect their oil supplies and provide for more flexible distribution through dispersion and concealment. They have developed new bulk storage capacity by the installation of small tanks at various locations and probably have established stockpiles of POL in drums and cans. It is estimated that the capacity represented by these expedients is small compared with the capacity lost by bombing.

B. Development of Alternative Transportation Routes

In many areas which have been bombed intensely during the Rolling Thunder operations the North Vietnamese are developing alternative transportation routes and other transportation means which are providing greater flexibility and capacity for movement of military supplies southward from North Vietnam to South Vietnam. Initial destruction of the land routes in the early part of 1965 forced the North Vietnamese to rely, to a greater extent, on coastal shipping and the use of inland waterways. In many places, inland waterways parallel existing roads and serve as alternate transportation routes. The most far-reaching effort, however, in terms of inputs, has been the construction of over 300 kilometers of roads and several bypasses around traffic chokepoints. In so doing, there has been an intense effort to take advantage of natural cover and to conceal these new routes and bypasses by camouflage. In addition to the use of waterways and new roads, the transportation system includes a restored portion of rail line parallel with route 15 south of Vinh. Bombing has also resulted in a more intensive use of the many foot trails, particularly in the area around the Demilitarized Zone. Frequently a new road is simply a foot trail which has been expanded to carry truck traffic. In addition, the Communists have expanded and improved the road net comprising that part of the supply route which passes through Laos to South Vietnam.

The principal effort to construct and maintain alternate routes in North Vietnam has been in the area southward from Thanh Hoa. The North Vietnamese are developing these inland north-south roads to provide a choice of routes south through Mu Gia Pass, where route 15 crosses the Laotian border and continues as route 12. At Mu Gia Pass there are now two bypass roads around the chokepoint and a third under construction to insure the uninterrupted movement of supplies. A new road under construction from route 911 will provide a new transport connection between North Vietnam and Laos. The North Vietnamese are continuing to improve route 12 in Laos and to develop bypass roads at chokepoints in their determination to keep this major border crossing open to provide another supply route to South Vietnam. The following roads and a segment of railroad were constructed or improved during 1965 in Military Region IV (south of Thanh Hoa) in North Vietnam:

<u>Route</u>	<u>Length (Kilometer)</u>	<u>Possible Alternate for Sections of Route</u>
101 west from Dong Hoi (17 29 N 106 36 E)	35	1A
701, 704, and 116 between Thanh Hoa and Vinh (improvement)	82	1A
15 northwest from Vinh (improvement)	60	1A
74 (improvement)	84	15 and 1A
83, 831, 832	81	15 and 1A
Railroad segment south from Vinh	70	15
Total length of alternate routes	<u>412</u>	

The continued expansion of this road net in southern North Vietnam would further increase its capacity to keep military supplies moving south. In addition, the construction of routes 911, 922, 96, 165 and improvements to route 16 in Laos during 1965 offer a choice of routes to South Vietnam on the southernmost segment of the supply line from Hanoi. The effort to build additional routes in Laos has been equally as intense as the effort in southern North Vietnam.

The manpower and materials committed to restoring roads and stream crossings destroyed by bombings has been sufficient to provide the necessary resources for development of alternative routes. An estimated 70,000 to 100,000 workers have been organized into work camps and smaller elements such as mechanized units or bridge units. Despite these large numbers, shortages of technically experienced road and bridge builders exist. To alleviate this shortage, groups of 200 workers have been sent to Hanoi and possibly China for training in the operation and maintenance of construction equipment. About 60,000 youths from the Hanoi-Haiphong area were drafted for construction in southern North Vietnam during 1965 to meet the needs for construction labor, and a new, broader program is currently under way throughout the country to draft even more young people into the program. They have caused complaints because of their inexperience, but they have effectively filled the need for mass labor to repair bomb damage. Although the greater share of this labor is employed in restoration of existing roads and the building of bypasses, about 21,000 workers are involved in the construction of new roads.

Although there are shortages of construction equipment, recent information indicates some additions to existing inventories through imports from the USSR. The North Vietnamese method of construction using mass labor, however, tends to offset the shortage of equipment. It is estimated that 3,000 North Vietnamese are responsible for each 25-kilometer segment of new road construction, or about 120 workers per kilometer. They have completed 116 kilometers of new roads and 226

kilometers of improvements to existing roads in approximately 7 months for an overall average completion of 1.6 kilometers per day. The rate of road construction on individual projects varies according to the priority placed upon it.

C. Increased Flow of Supplies from other Communist Countries

In 1965, primarily as a reaction to allied bombing, North Vietnamese imports of military and military-related economic goods from other Communist countries increased 170,000 tons over the 1964 level.* Military equipment and supplies, mainly for defense purposes, made up more than half of this increase, as shown in the following tabulation:

	<u>Increase Above 1964</u>	
	<u>Volume</u>	<u>Unit</u>
Increase in total imports	<u>170,000</u>	Metric tons
Military	<u>90,000</u>	Metric tons
Of which:		
SAM sites	15 to 20	Equipment for sites
Antiaircraft artillery	1,000 to 1,200	Units
Aircraft	8	Il-28 bombers
	11	MIG-21 jet fighters
	68 to 69**	MIG-15/17 jet fighters
Radar (not included with SAM equipment)	67	Units
Economic	<u>80,000</u>	Metric tons
Of which:		
Petroleum	26,300	Metric tons
Motor vehicles	3,890	Units
Rails and rail joints	6,980	Metric tons
Suction dredges	58	Units
Pontoon bridges	200	Metric tons

* For an appraisal of the dollar cost of the increased military and economic aid to North Vietnam, see section IV.

** Including 36 flown in from China in 1964 after the Gulf of Tonkin incident.

The increase in imports of economic goods resulting from the bombing, almost all of which was military related, began as early as April from China. Imports of similar goods from the USSR, however, occurred mainly during the latter half of 1965. Imports of cargo trucks, other transport equipment, and petroleum rose sharply over the 1964 level. In spite of air attacks, North Vietnam's truck inventory reached 13,000 to 15,000 military and civilian trucks by the end of 1965, an increase of about 3,000 trucks during the year. Large imports of construction equipment and supplies, including bridge steel, pontoon bridges, rails, and small dredges, aided the North Vietnamese in not only maintaining but also increasing the flow of supplies to the southern part of North Vietnam as the year progressed.

1. Increased Imports by Land Transport

Allied air attacks were indirectly responsible for an estimated 110,000 tons out of the total increase (about 160,000 tons) in North Vietnamese imports by land in 1965 (see Table C-13). North Vietnam countered the air attacks by importing by land transportation an estimated 90,000 tons of military equipment and supplies, which apparently moved almost entirely overland, and 20,000 tons of military-related economic goods. Only about 20,000 of the 90,000 tons of military goods can be quantified by type. Equipment for the 15 to 20 active SAM sites currently deployed in North Vietnam made up the largest volume of identified imports of military goods. An estimated 1,000 to 1,200 antiaircraft artillery weapons out of a current total in North Vietnam of about 2,240 also were imported because of the bombing, as were almost 70 of the 160 radars not included with SAM equipment. Eight Il-28 bombers from the USSR and 44 MIG-15/17 jet fighters from China were flown to North Vietnam as a result of airstrikes. In addition, the USSR sent 24 or 25 MIG-15/17's and 11 MIG-21's by rail. The approximately 70,000 tons of military goods that cannot be quantified by type included large imports of artillery, tanks, mortars, small arms, and ammunition.

Increased imports of economic goods resulting from air attacks included at least 1,330 cargo trucks from China transported overland out of a total of at least 3,310 cargo trucks* imported from all Communist countries by land and sea in 1965 (see Table C-14). China also supplied 8 crane trucks out of a total of 510 dump trucks and other construction vehicles imported in 1965 by the North Vietnamese. Increased shipments of construction supplies such as bridge steel (including girders), rails, and asphalt; boats and barges; truck parts; bicycles and parts; and medical supplies were noted but cannot be quantified. In addition, at least 4 locomotives and 64 freight cars were imported. China probably also has allowed the North Vietnamese to use some of its meter-gauge rolling stock normally used for Chinese transit traffic in order to counter the destruction of North Vietnamese rolling stock.

* Excluding dump trucks and other specialized cargo trucks.

Table C-14

Estimated North Vietnamese Imports of Motor Vehicles a/
1965

<u>Type</u>	<u>By Land</u>	<u>By Sea <u>b/</u></u>	<u>Total</u>
General cargo trucks	<u>1,331</u>	<u>1,981</u>	<u>3,312</u>
Dump trucks <u>c/</u>		<u>392</u>	<u>392</u>
Other construction vehicles	<u>8</u>	<u>113</u>	<u>121</u>
Bulldozers		43	43
Scrapers		44	44
Graders		6	6
Excavators		6	6
Automotive cranes	8	6	14
Truck workshops		8	8
Other vehicles	<u>30</u>	<u>165</u>	<u>195</u>
Tank trucks		2	2
Ambulances		38	38
Refrigerator trucks	30		30
Truck tractors		8	8
Jeeps		103	103
Buses		5	5
Automobiles		9	9
Total	<u>1,369</u>	<u>2,651</u>	<u>4,020</u>

a. Reported shipments either received or en route. The actual totals probably are larger.

b. From the USSR and Eastern Europe.

c. Although most of these trucks are related to economic aid projects, they could be used for construction projects resulting from the bombing.

2. Increased Imports by Sea Transport

Much of the 13-percent increase in North Vietnamese seaborne imports from Communist countries in 1965 over the 1964 level can be attributed to allied bombing. All of the 17-percent increase in imports of petroleum from Communist countries and much of the 14-percent increase in general cargoes can be attributed to the bombing.

The most striking increase in the category of general cargo is that for motor vehicles. Communist ships carried 2,650 motor vehicles

of all types to North Vietnam in 1965, compared with about 100 in 1964. All of these vehicles originated in Communist countries, and most were suitable for military or construction use. Another significant increase occurred in Soviet shipments of railroad rails and rail joints, presumably for rebuilding bomb-damaged rail lines. In 1964, only 52 tons of rails were shipped to North Vietnam from Communist countries. The following tabulation shows the increases described above:

Commodity	Unit	Increase in 1965 Above 1964	Percent Increase in 1965 Above 1964
Increase in total seaborne imports	Metric tons	59,600	13
Of which:			
Petroleum	Metric tons	24,300	17
Motor vehicles	Units	2,550	2,550
Railroad rails and rail joints	Metric tons	6,732	12,900
Pontoon bridges	Metric tons	200	a/
Suction dredges	Units	58	a/

a. Few or no imports in 1964.

D. Adjustments in Civilian Living Standards

Civilian living standards in North Vietnam, which are barely above subsistence even in normal times, have generally declined as a result of allied airstrikes, but the impact of bombing has varied widely despite some sacrifice in the standard of living by almost every segment of the civilian population. The regime has demanded extra work, largely without compensation, of almost every able-bodied person and has postponed some benefits, such as vacations at "health camps," which were previously awarded to a small number of outstanding workers. Moreover, higher rice procurement quotas in 1965 have probably reduced food availabilities in rural areas, while urban residents have had to bear the disruptions caused by evacuation and by reduction of some urban services. Families living in target areas and those with a high ratio of dependents to wage-earning members have suffered far greater hardships than other civilians, and the regime has apparently made little effort to provide assistance to those civilians feeling the greatest effects of the bombing. For the most part, however, adequate levels of consumption have been maintained, largely because of the relatively unimpaired functioning of the subsistence sector of the economy, which supports about 85 percent of North Vietnam's population.

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The greatest decline in living standards has been in the southern part of the country, where extensive bombing has severely disrupted the distribution system and economic activity in the urban areas as well as destroying some civilian property and where the influx of large numbers of workers to repair bomb damage has strained local supplies of food and other consumer goods.

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shortages of essential consumer goods, loss of property, and declines in income as a result of interruption of normal economic activity have created extremely difficult living conditions, particularly in the towns. The primarily rural nature of the southern provinces has permitted continued functioning of the subsistence sector, but rural families in the southern provinces have probably suffered some decline in living standards as they have had to provide assistance to urban relatives and have probably had some soldiers and repair workers billeted in their homes.

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Inhabitants of other parts of the country have been most affected by strains on incomes, by physical dislocations, and by the reduced quality of many consumer goods and services, although distribution and production difficulties as well as stockpile requirements have probably intensified normally tight supplies of consumer goods. Incomes of many urban and rural families have undoubtedly fallen because of a diversion of working members to low-paying or uncompensated defense and reconstruction tasks and as a result of the elimination of pay for overtime work in industry. Moreover, evacuation of dependents from urban areas has involved a sharp reduction in living standards for city dwellers forced to live under more primitive conditions in the countryside. The maintenance of separate households has imposed considerable financial burdens on some families. Little information is available on the extent of evacuation, and apparently many of those who left subsequently returned to the cities. However, several hundred thousand urban residents may have moved to rural areas. Those remaining in the urban areas have been forced to accept a less desirable diet -- part of the rice previously included in food rations has been replaced by less popular secondary foods, such as manioc and sweet potatoes -- and they have probably been deprived of at least some electricity for home use because of the destruction of two large powerplants that were included in the power grid linking North Vietnam's major cities. In addition, dispersal of some schools, hospitals, and industrial facilities from urban areas has probably resulted in reductions in the quality of health and educational services and in the quality of many consumer goods.

E. Other Actions to Minimize the Effects of Air Attack

The North Vietnamese authorities have taken steps to reduce casualties and damage in North Vietnam. North Vietnamese civil defense has probably supplemented US restraint in target selection to hold civilian casualties at a relatively low level.

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Measures taken to reduce casualties in North Vietnam include the thinning out (or strategic evacuation) of cities and some supplementary population dispersal during daylight hours, when air attack is considered more likely. In addition, the North Vietnamese rely for defense on the extensive preparation and use of foxholes, trenches, and air raid shelters. In some cases the hours of school, work, and marketing have been adjusted to avoid large concentrations of people during the day.

1. Civil Defense

Civil defense is controlled nationally by a Directorate of Peoples Antiaircraft Defense in the Ministry of Defense and at the province and town level by local civil defense committees. The latter coordinate the militia, fire departments, and the civilian "self-defense" units which are organized and trained for medical aid, firefighting, shelter supervision, and rescue and repair activities. The organization of mobile medical units and stationary first aid points has been reported.

The organization of civil defense at important factories and transportation worksites includes a combat group armed with machineguns and rifles to fire at attacking planes as well as the conventional first aid, firefighting, and rescue units. Shelters for workers have been prepared. In some cases these are linked by communicating trenches.

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and worksites to disperse and protect storage of valuable property. Areas of dispersed storage have been seen in recent weeks along North Vietnamese transportation routes.

2. Resettlement Evacuation

Since early 1965, some North Vietnamese civilians have been evacuated to northern areas from Hanoi, Haiphong, and the southern coastal towns. Others have been evacuated on a resettlement basis to areas not far from their home city. Old people, women, children, and the unemployed are the most frequently identified evacuees. Nearly all schools and university faculties have left the central Hanoi area, and similar precautions have been taken for schools in other urban centers. Elements of the central government have left Hanoi to set up at points not more than 50 miles distant. Local government offices in other cities or towns have apparently relocated to nearby rural areas or are prepared to move quickly when necessary.

The government has assisted evacuees in the organization of movement and by reducing transportation fares, but the principal costs are borne by individuals or families. The exact extent of resettlement remains unknown.

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Some reports from Hanoi have indicated that as many as 300,000 have left the city. A Soviet reporter in Haiphong recently stated that "nearly all the children and

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part of the adult population have been evacuated." Although other reports have not indicated resettlement evacuation of this magnitude, a one-third evacuation of major centers is considered possible.

3. Changes in Work Hours and Dispersal

Frequent air alerts during daylight hours have apparently altered the routine of North Vietnamese cities. In and around Hanoi, government offices, schools, and some shops have shifted their work to the early morning and the evening hours. Thus work and school go on from about 0400 to 0900 and from about 1700 to 2100 hours. Similarly, schools in a number of other localities have shifted to morning or evening sessions, or both. Market places have been reported as being open only at night in several cities south of Hanoi.

the population of some cities is partially dispersed, the people retreating to the countryside during the day and returning at night.

A Prague newspaper carried an article stating that practically the entire population of Nam Dinh leaves home for nearby villages during the day.

It is unlikely that the entire population of larger urban areas is dispersed during daylight. There is sufficient evidence to support a belief that a dispersal program exists for substantial groups of the population, particularly children, older people, and those engaged in the services sector of the economy such as transportation and the wholesale and retail trades. The nature of the dispersal program for workers in industry is less well defined. In some industries the nature of the production process would preclude midday shutdowns. In sanctuary areas, such as Hanoi and Haiphong, there is no need to shut down. It seems probable, however, that factory operations are halted for long periods in target cities such as Vinh and Nam Dinh. It is equally probable that, although the entire labor force is not sent to the country during daylight hours, the regime does attempt to avoid the daytime concentration of workers in facilities that are likely to be the target of air attack and, in addition, to provide nearby shelters for the work force.

Workers are expected to make up time lost from their job in air raid precautions. Local officials are instructed to incorporate into their air defense plans the steps necessary to maintain production.

4. Shelter

widespread and continuing construction and improvement of air

raid shelters in North Vietnamese cities. The existence of foxholes and trench shelters is apparent in photography of such target areas as Vinh, Nam Dinh, and Dong Hoi. It appears that every family must have its own foxholes or trench shelters; others are dug at frequent intervals along city streets. During 1965, many trenches have been roofed with timber or other available materials and covered with earth. In Hanoi, some trench shelters have been lined with brick and roofed with masonry. More elaborate concrete shelters have been seen at government buildings and hotels.

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It must be concluded, therefore, that sufficient nearby shelter of some type is available to accommodate practically the entire population of cities and potential target areas, especially those that have already been subjected to airstrikes or overflights by US and South Vietnamese aircraft.

blast walls as being erected at building entrances in Hanoi, and the taping of windows has also been noted. Prefabricated concrete elements such as sewer pipes are now being used in improving simple excavated trenches in Hanoi and Haiphong.

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5. Industry Relocation

There have been about a dozen reports of industry being evacuated from North Vietnamese cities, principally from Hanoi. A

some workers had left Hanoi together with their production equipment. In May a North Vietnamese official told Polish journalists that factories were being moved from cities and that some were even installed underground. A reporter from Eastern Europe indicated that some industry had been removed from Nam Dinh when he made reference to those "plants which have not yet been evacuated." individuals who had been evacuated or were to evacuate with their factories. On 26 August 1965 the Deputy Chief of the Industrial Office of the Premier stated that a need existed to decentralize industrial production.

The amount of industry moved from North Vietnamese cities is unknown. What has been accomplished is probably limited to small factories and cooperatives with easily moved machines and relatively few employees.

6. Transport Movement

The North Vietnamese have used camouflage, movement by night with reduced lighting, and dispersal to reduce transport vulnerability. Camouflage efforts have included painting vehicles and railroad cars in dull colors and with irregular patterns. In addition, camouflage nets and foliage are used to break the outlines of motor vehicles, trailers, and boats. Reporting during the past year indicates that a great deal

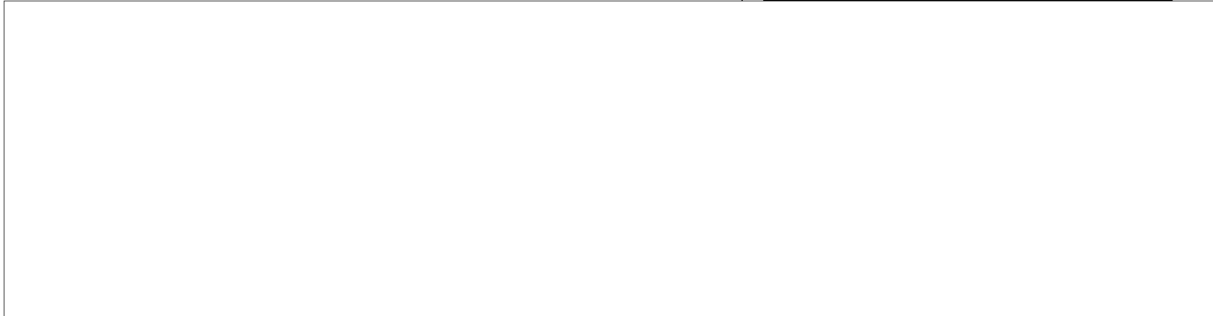
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of road movement, including both civilian vehicles and military convoys,
has taken place during the hours of darkness.

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IV. Costs to Communist China and the USSR of Additional Support to North Vietnam

In 1965 the levels of military and economic assistance provided to North Vietnam by Communist China and the USSR increased sharply and are believed to have totaled somewhere in the range of \$250 million to \$400 million. After a two-year lull, economic aid, believed to be on the order of \$100 million to \$150 million, was extended to North Vietnam in 1965. Military aid, which previously had been supplied on a very small scale, reached an estimated level of \$150 million to \$200 million in 1965. Technical aid grew to a value estimated at \$10 million to \$25 million.

This increased assistance to North Vietnam appears to be largely in response to the intensified allied air offensive. By far the largest part of the military equipment (by value) delivered in 1965 represented SAM sites, antiaircraft artillery, and related air defense equipment, most of which was supplied by the USSR. Communist economic and technical assistance to North Vietnam in 1965 consisted in large part of equipment and personnel needed to restore and maintain power, transport, and communications.

In spite of the increased costs to Communist China and the USSR of assisting North Vietnam, these costs in 1965 -- both direct and indirect -- were small in terms of Chinese and Soviet capabilities to extend military and economic aid. In 1965, for example, the USSR supplied the less developed countries of the Free World with more than twice as much military equipment (by value) as it supplied to North Vietnam in the same period. Similarly, Soviet economic aid extended to the less developed countries in 1965 was about twice the amount that the USSR is believed to have extended to North Vietnam. China, which supplied some 40 MIG-15/17 fighters to North Vietnam following the Tonkin Gulf incident in 1964, is believed to have provided only small quantities of military aid in 1965. China's economic aid also seems to have been on a relatively modest scale in 1965; indeed, its most significant contribution appears to have been the thousands of Chinese support personnel assigned to duty in North Vietnam. Assistance from the Eastern European Communist countries has been limited thus far to token supplies of small arms, medicines, and a few industrial specialists.

A. Costs of Soviet and Chinese Military Aid

In 1965 the USSR became by far the major source of weapons to North Vietnam, supplying somewhere between 70 and 95 percent (by value) of the total estimated military equipment received (see Table C-15). More than four-fifths of the Soviet deliveries consisted of air defense equipment, including operational SAM sites, antiaircraft artillery, and radar, which together reached an estimated value of roughly \$115 million.

Other large deliveries of military goods in 1965 included some 50-odd jet aircraft, of which more than 40 were supplied by the USSR and the remainder by Communist China. The USSR and China together are estimated to have delivered more than 4,000 trucks to North Vietnam in 1965, most of which are believed to have been used in military or defense-related transport (for example, hauling construction crews and supplies for repair of bridges and highways).

In addition, China and the Communist countries of Eastern Europe supplied North Vietnam with machineguns, small arms, and ammunition probably valued at around a few million dollars in 1965. The chief contribution of the Eastern European countries in 1965 was the sharply increased supply of medicines and medical equipment, estimated to have been on the order of a couple of million dollars. China also engaged in repairing North Vietnamese gunboats and in naval patrol activity in North Vietnamese waters during 1965, but the costs of these activities, although believed to be only a few million dollars, cannot be reliably estimated.

An additional aspect of the costs of 1965 military aid is the terms under which it was extended. The Chinese have specified that some of their military assistance is in the form of grants; it seems likely that this also is true of some Soviet deliveries. The value of Chinese and Soviet military aid together is twice the value of North Vietnam's exports to the entire Communist world in any recent year. It therefore would be unrealistic, to say the least, to expect North Vietnam to be economically capable of repaying so large a debt.

B. Costs of Communist Economic Aid

New extensions of economic aid to North Vietnam increased rapidly in 1965, following a virtual cessation in new economic aid agreements during 1962-64. The economic aid extended in 1965, thought to have been somewhere on the order of \$100 million to \$150 million, was nevertheless well below that extended in several of the years prior to 1962 (see Table C-16). This total was also well below -- less than one-fifth -- the value of Communist economic aid to the less developed countries of the Free World in 1965.

The 1965 aid, unlike that of any previous year, involved commitments not only by China and the USSR but also by all the other Communist countries. This broader participation of the Communist camp in economic aid to North Vietnam reflects the growing pressure on these countries to give tangible proof of their support to North Vietnam's military effort against the United States. The token character of their response, however, is suggested by Communist propaganda concerning the 1965 aid agreements. In no single case was the value of the aid extended made public. From intelligence information it was later

learned that in at least two of the agreements -- with Hungary and Rumania -- relatively small amounts of aid were involved: \$11.1 million and \$4.4 million, respectively. Moreover both Soviet and Eastern European spokesmen, in responding to Chinese charges of tokenism, have attempted to justify the modest scale of their aid to North Vietnam.

Although relatively little information is available on the composition of the 1965 aid, the evidence at hand suggests that it may have consisted in large part of supplies of materials and equipment made necessary by the war, such as medical supplies and equipment to restore transport, power, and other economic capacity. The North Vietnamese, after successfully concluding a series of economic aid agreements with almost every Communist country in mid-1965, were compelled to send out another aid-seeking mission at the end of the year.

In addition to extending material aid, most of which was in the form of grants, several additional categories of economic aid costs were sustained by Communist China, the USSR, and the Eastern European Communist countries in their 1965 aid to North Vietnam. The most important was the dispatch of technical, advisory, and other special personnel to North Vietnam (see C, below). Additional costs were incurred by a number of Communist countries in the form of public donations to North Vietnam, amounting to no more than several million dollars in 1965, and in the postponement of certain North Vietnamese debt obligations.

Between February 1965 and January 1966, three Communist countries -- the USSR, Hungary, and Rumania -- agreed to a deferment of debt repayments by North Vietnam. Although details are lacking, it is likely that the agreements cover the 1966 installments on North Vietnam's long-term debts to these three countries. It is difficult to assess, however, the extent to which this should be counted a real loss, in terms of imports foregone in 1966, for despite North Vietnam's indebtedness to the Communist countries (estimated to be around \$500 million at the beginning of 1966), North Vietnam has consistently run an import surplus in its trade with these countries. In view of North Vietnam's chronic difficulty in repaying earlier debts, its creditors would have been optimistic, indeed, to expect repayments to be made under the conditions likely to exist in 1966.

C. Costs to the Communist Countries of Technical Assistance*

In 1965 the number of personnel from the USSR, Eastern Europe, and Communist China, particularly the latter, in North Vietnam increased rapidly over previous levels. It is estimated that some 30,000 Chinese special troops were sent into the northern regions of North

* Technical assistance is used here to cover only the personnel sent to North Vietnam or the North Vietnamese personnel trained in Communist countries. Other technical services are not included.

Vietnam where they were associated mainly with maintaining and repairing North Vietnamese transport and communications to the north. A rapid influx of Soviet technicians accompanied the introduction of the SAM sites in mid-1965, although some of the Soviet technicians in North Vietnam were engaged in jet aircraft training and maintenance. The Eastern European Communist countries furnished a much smaller number of personnel, most of whom apparently were medical or industrial specialists. The total value of technical assistance to North Vietnam in 1965, as shown in Table C-17, is estimated to have been roughly between \$10 million and \$25 million.

D. Costs to North Vietnam Associated with Trade and Aid

In addition to the costs of Communist aid to North Vietnam, the country itself bore certain costs associated with its foreign trade and its aid receipts in 1965. Export earnings, particularly those from the Free World, appear to have declined in 1965, probably reflecting in large part the disruption of normal economic activity brought about by the allied air offensive. Although data on North Vietnam's 1965 trade are fragmentary, it seems likely that total exports may have declined by as much as 10 percent -- that is, by around \$10 million -- in 1965. Identified seaborne exports to the Free World alone of coal, cement, and apatite -- three of North Vietnam's leading exchange earners -- declined sharply in 1965, representing a loss of some \$5 million to \$6 million.

North Vietnam also bore additional costs associated with the more than 30,000 military personnel believed to have served in the country in 1965. Assuming that food represented virtually all of such costs to North Vietnam, it is estimated that these costs amounted to slightly more than \$1 million.

Table C-15

Estimated Soviet and Chinese Deliveries of Military Equipment
to North Vietnam
1965

	USSR		Communist China		Total	
	Quantity	Value (Million US \$)	Quantity	Value (Million US \$)	Quantity	Value (Million US \$)
SAM sites (operational)	15 to 20	80.0			15 to 20	80.0
Antiaircraft guns	1,000 to 1,200	30.0	N.A.	N.A.	1,000 to 1,200	30.0
Aircraft	44	15.0	8	1.0	52	16.0
Il-28 bombers	8	2.8			8	2.8
MIG-15/17's	25 ^{a/}	3.2	8	1.0	33	4.2
MIG-21's	11	8.8			11	8.8
Trucks and other vehicles	2,650 ^{b/}	10.0 ^{b/}	1,370	5.0	4,020	15.0
Radar		5.0		5.0		10.0
Medicines		2.0 ^{b/}	Negl.	Negl.		2.0
Jet fuel	1,531 metric tons	0.1			1,531 metric tons	0.1
Minimum estimated total		<u>142.0</u>		<u>11.0</u>		150 to 200 ^{c/}

a. Based on reported delivery of 24 or 25 aircraft.

b. Imported from the USSR and Eastern Europe, together.

c. The estimated total value of military deliveries also includes small arms provided by Communist China and Eastern Europe and medical supplies provided by Eastern Europe. Although the value of these deliveries cannot be reliably estimated, it is known to be small, probably amounting to only a few million dollars.

Table C-16

Communist Economic Aid Extended to North Vietnam a/
1955-65

	Million US \$										
	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1963-64</u>	<u>1965</u>	<u>1955-65</u>
Communist China	200.0	<u>b/</u>	<u>b/</u>	<u>b/</u>	100.0	<u>b/</u>	157.0	<u>b/</u>	<u>b/</u>	N.A. <u>c/</u>	457.0
USSR	100.0	7.5	11.8	20.7	25.0	200.0	3.9	N.A.	<u>b/</u>	N.A. <u>d/</u>	368.9
Eastern Europe	50.2	8.3	7.0	<u>b/</u>	2.5	Negl.	62.5	<u>b/</u>	<u>b/</u>	N.A. <u>e/</u>	130.5
Total	350.2	15.8	18.8	20.7	127.5	200.0	223.4	N.A.	<u>b/</u>	<u>100 to 150 f/</u>	<u>1,056.4 to 1,106.4 f/</u>

- a. In addition, insignificant amounts of aid have been extended by Albania, Mongolia, and North Korea.
b. No extensions are known to exist, although some may have taken place.
c. New aid includes a grant in July and a credit in December; values are not available.
d. New aid includes a grant in February, a credit in July, and a grant and credit in December; values are not available.
e. All Eastern European Communist countries made available new assistance; although values are not available, the amounts are believed to be small.
f. Total extensions for 1965 have been estimated; however, a regional breakdown is not available.

Table C-17

Estimated Communist Technical Assistance to North Vietnam
1965

	Military		Economic	
	Number	Cost (Million US \$)	Number	Cost (Million US \$)
Communist technicians in North Vietnam				
Communist China	30,000	2.0	200 to 500	2.0 to 4.0
USSR	1,000 to 1,500	5.0	500 to 1,000	4.0 to 8.0
Eastern Europe	100 to 200	0.5	50 to 100	0.5
North Vietnamese pilot trainees in the USSR	50	0.5		
North Vietnamese trainees in Communist China	N.A.	N.A.	N.A.	N.A.
Estimated total		5.0 to 10.0		5.0 to 15.0

V. Political Effects of the Bombing

The bombing has not had a major effect in shaping Hanoi's decision on whether or not to continue the war in Vietnam. There is evidence that some of the policymakers in Hanoi are concerned over the long-range effect of the bombings on the North Vietnamese economy. Continuation of the air attacks would probably sharpen the apprehensions of this group and might also cut into the morale and staying power of the more hard-line elements in the North Vietnamese leadership. Nevertheless, the regime probably continues to base such decisions mainly on the course of the fighting in the South and is willing to suffer even stepped-up bombing so long as prospects of winning in the South appear to be reasonably good. If the Viet Cong began to show significant weakness in the South, however, the effect of the bombing would play a larger part in Hanoi's decisions on how to handle the conflict.

Evidence on the effect of the bombing on the morale of the people suggests that the results have been mixed.

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Because the airstrikes have been directed away from urban areas, morale has probably been damaged less by direct bombing than by the indirect effects of evacuation of urban population, splitting of families, and the inconveniences of air raid drills.

If bombing were directed at urban centers, there would be a sharper drop in morale. But even in this event, popular morale would not be expected to collapse or the regime to respond to morale problems by making major shifts in its policies.

Hanoi's political relations with its allies have in some respects been strengthened by the bombing. The attacks have had the effect of encouraging greater material and political support from the Soviet Union than might otherwise have been the case. While this Soviet aid has complicated Hanoi's relationship with Peking, it has reduced North Vietnam's dependence on China and thereby has given Hanoi more room for maneuver in its own behalf.

VI. Discussion of Sources and MethodologyA. Economic Targets

The inventory of physical damage in the North Vietnamese economic sector was assessed in several ways, depending on the availability of pre-strike and post-strike information on the specific target systems. In the case of powerplants, petroleum storage facilities, manufacturing plants, and JCS bridges, assessments of damage were made by industry specialists on the basis of photographic interpretation of the damage to the bombed facilities.

The damage inflicted on facilities was recorded in two ways: (1) the cost in US dollars of restoration of the damaged facility and (2) the damage to the facility expressed in terms of a reduction in national capacity. Such factors as the actual utilization of capacity and its meaning to the economy must be viewed when using the latter measure as a bomb damage indicator. Target descriptions in the 94 Target List, reductions in national capacity found in the DRV Target Study Analysis, and the Bomb Damage Assessment Book (BDA) recording damage inflicted on all targets during the air war, as well as aerial photography

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Damage and loss to rail yards, maritime ports, locks, agriculture, and exports were handled in a somewhat different manner. In addition to the above-mentioned sources, the assessment of damage to rail yards was based on pilot reports recorded in the BDA and yard descriptions in the North Vietnam Rail NIS. Ports were evaluated by combining [] cost of damage estimates, BDA information, and descriptions in the 94 Target List. Damage to the single lock attacked was assessed by evaluating the pre-strike descriptions found in the 94 Target List with the BDA description of damage. Agricultural loss was estimated on the basis of a projected crop loss due to irrigation difficulties. Export losses were calculated for apatite and cement. By comparing figures of known North Vietnamese exports, [] and BDA information, it was possible to attribute the loss in export exchange to the air war. Costs were calculated by multiplying going world prices of cement and apatite by the net reduction in the 1965 exports of these two commodities.

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B. Military Targets

[] the 94 Target List, the DRV Target Study Analysis, and the BDA, it was possible to elaborate on the statistical information used [] to represent the damage inflicted on military targets in North Vietnam. Destroyed and remaining capacities were evaluated with respect to known operational needs of the North Vietnamese military. Costs of reconstruction, priorities,

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logistics, and the locations of struck targets were given consideration. Particular emphasis was given to the importance and location of targets not yet struck.

C. Armed Reconnaissance

Rough cost estimates were made for each of the items reported destroyed or damaged.

D. Casualties*

Examination of photography has shown that in the localities with less population there has been relatively more damage to civilian-associated housing and activities. In addition, the smaller localities are believed to have received less perfect warning of airstrikes and have less well-established civilian defense measures than a locality of the size of Nam Dinh. Furthermore, in the smaller localities civilian housing is less well constructed.

To take these considerations into account, the populations of Urban Area X as well as all other urban areas subjected to attack have been divided into the population of Nam Dinh to obtain the necessary weight:

Population of Nam Dinh: 90,000 divided by population of X (10,000) equals 9.

The calculations have then been completed as follows:

3 times 9 equals 27 minimum casualties.

5 times 9 equals 45 probable casualties.

1. Civilian Casualties in Urban Areas

The city of Nam Dinh was used as a case study for the purposes of constructing a methodology for calculating casualties in urban areas. As a consequence of six airstrikes, the casualties estimated for this city are a minimum of 30 and probably 45. The population of

Nam Dinh is 90,000. Therefore, the estimates of casualties ranged from 1 per 18,000 in population to 1 per 12,000 in population. In applying these findings to other urban areas, only two variables have been used. The first is the number of strikes and the second is the population of the various localities. Thus:

Urban area - X

Number of strikes - 6

Population - 10,000

6 times 10,000 equals 60,000

60,000 divided by 18,000 equals 3 casualties

60,000 divided by 12,000 equals 5 casualties

2. Civilian Casualties in Rural Areas

Most of the civilian casualties inflicted on North Vietnam by assigned strikes in rural areas appear to have been caused by collateral bombing -- bombs falling off target and hitting adjacent villages. In an effort to quantify the number of casualties under these conditions, sample villages in rural areas adjacent to JCS targets were studied.

The number of buildings in each village was determined by a visual observation from photoanalysis. In turn, the amount of physical damage to each village was observed following attack. To derive casualty estimates from the physical damage in the villages, three variables were considered:

- (1) JCS pre-strike estimates of casualties against a specific target.
- (2) German experience with Allied bombing in 1943,

The final average figure arrived at was one casualty for every four buildings destroyed or damaged in rural areas. In this report this ratio was applied to each JCS target area after a visual check of photography to determine the number and size of villages in the immediate vicinity (within 0.3 mile) of the target.

3. Civilian Casualties from Armed Reconnaissance

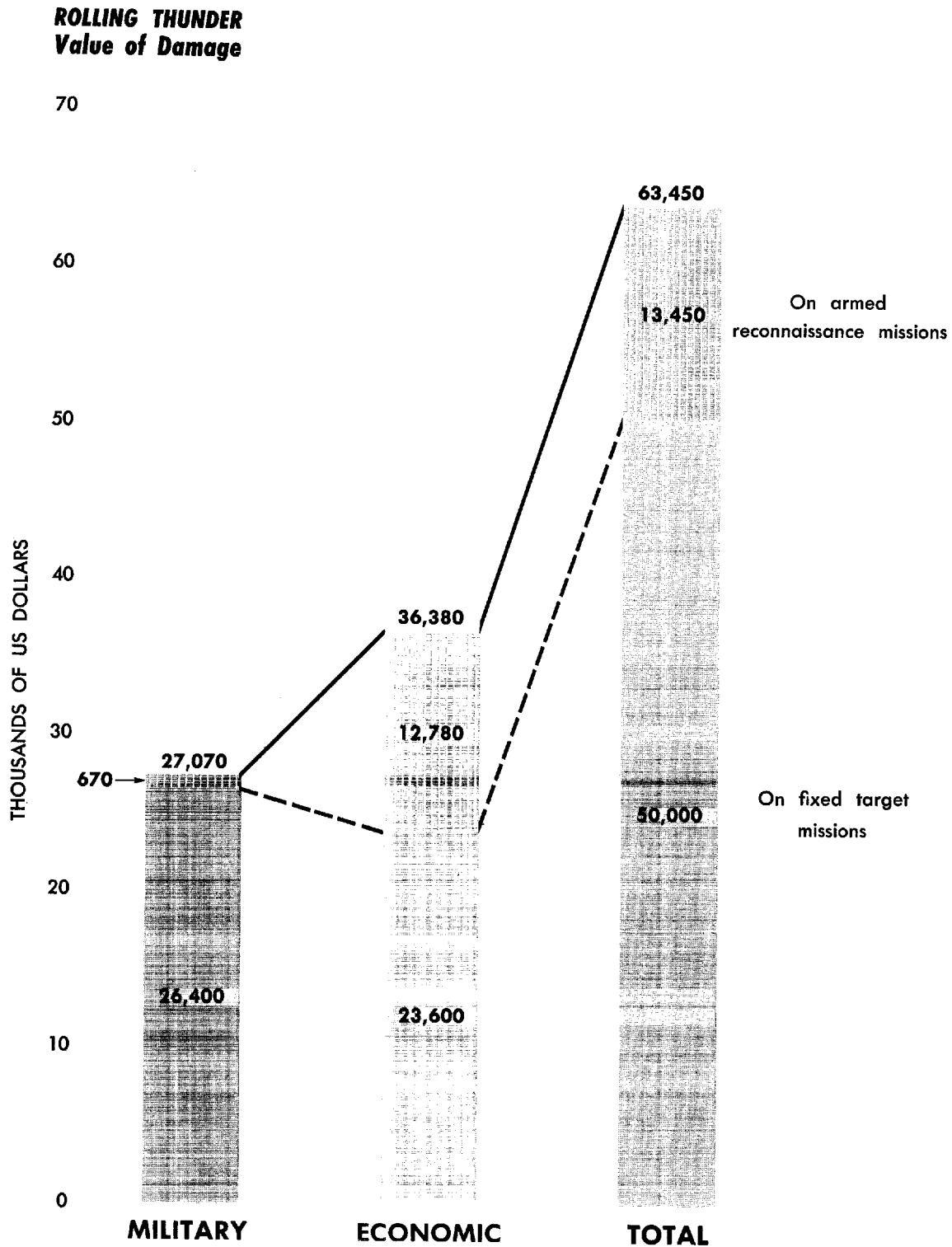
it was determined that an average of 1.3 casualties occurred per mission (averaging about 5 aircraft per mission). Analysis of armed reconnaissance casualties using both methods gave a considerable range with the first method yielding the "low" estimate and the second the "high" estimate.

4. Military Casualties

In estimating military casualties resulting from strikes against fixed targets the following factors were assumed: personnel are in a warned condition; barracks areas are occupied only on the date of the first strike; personnel are considered to be under hazard within the targeted area and an adjacent area defined as encompassing three CEP's (for purposes of this study, 600 feet in all directions from the outside perimeter of the target). Total casualties are estimated on the basis of pre-attack demographic studies of the target and the damage probability of the tonnage of ordnance actually dropped at the target adjusted by a standard formula to determine probable on-target hits. In this report the figures on total casualties derived by this methodology have been rounded and given as a range of plus or minus 10 percent.

Estimates of military casualties resulting from the armed reconnaissance program are achieved by applying uniform factors to the number of targets reported by pilots to have been damaged and destroyed. Thus for each truck or boat reported damaged or destroyed one casualty was assigned; for each locomotive or railroad car damaged or destroyed, 0.01 casualty was assigned; for each barracks, supply warehouse, or other building, 0.1 casualty was assigned; and for each antiaircraft, 0.3 casualty was assigned. While the casualty factors appear to be based on reasonable assumptions the armed reconnaissance estimates will be overstated to the extent that pilot reports often are exaggerated and overlapping. Since no alternative source of information is presently available for measuring the effectiveness of armed reconnaissance, an attempt was made to accommodate the bias by rounding total casualty figures derived by this methodology and applying a range of plus or minus 10 percent.

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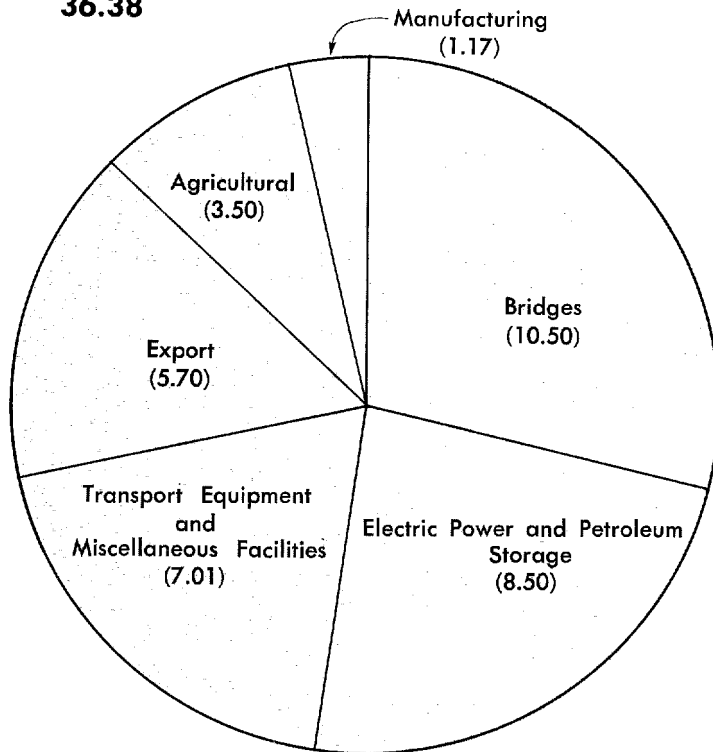
61343

C-1 Value of Damage Inflicted on North Vietnam During the Rolling Thunder Program

25X1

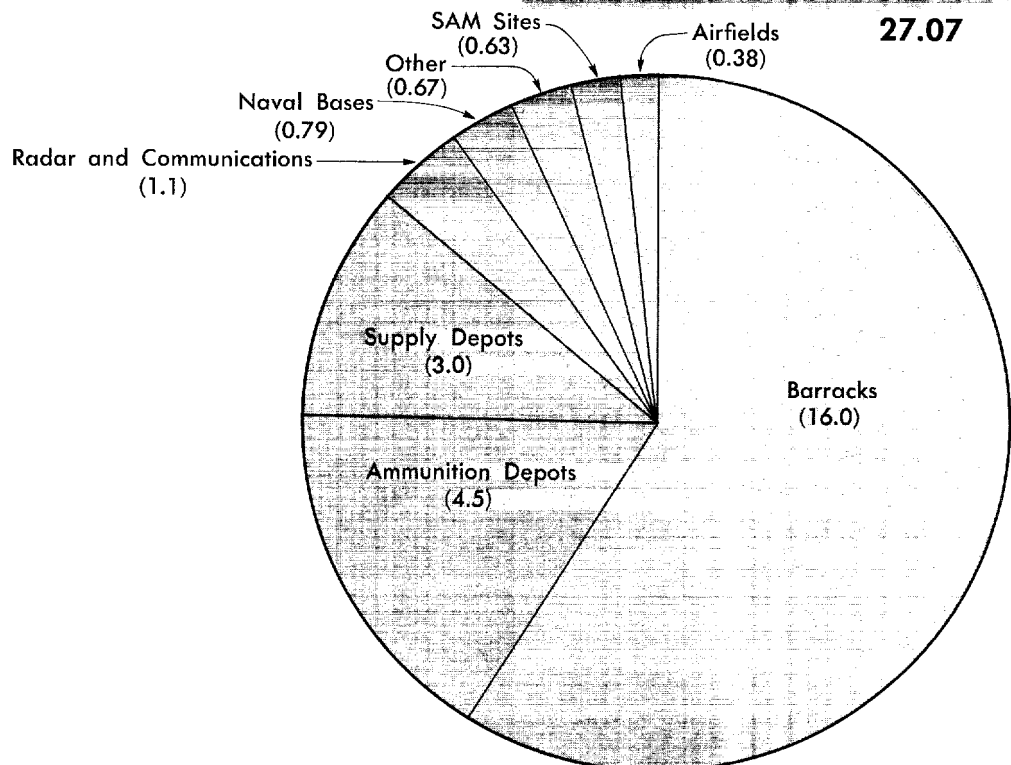
ECONOMIC

36.38



Value of Damage, by Sector

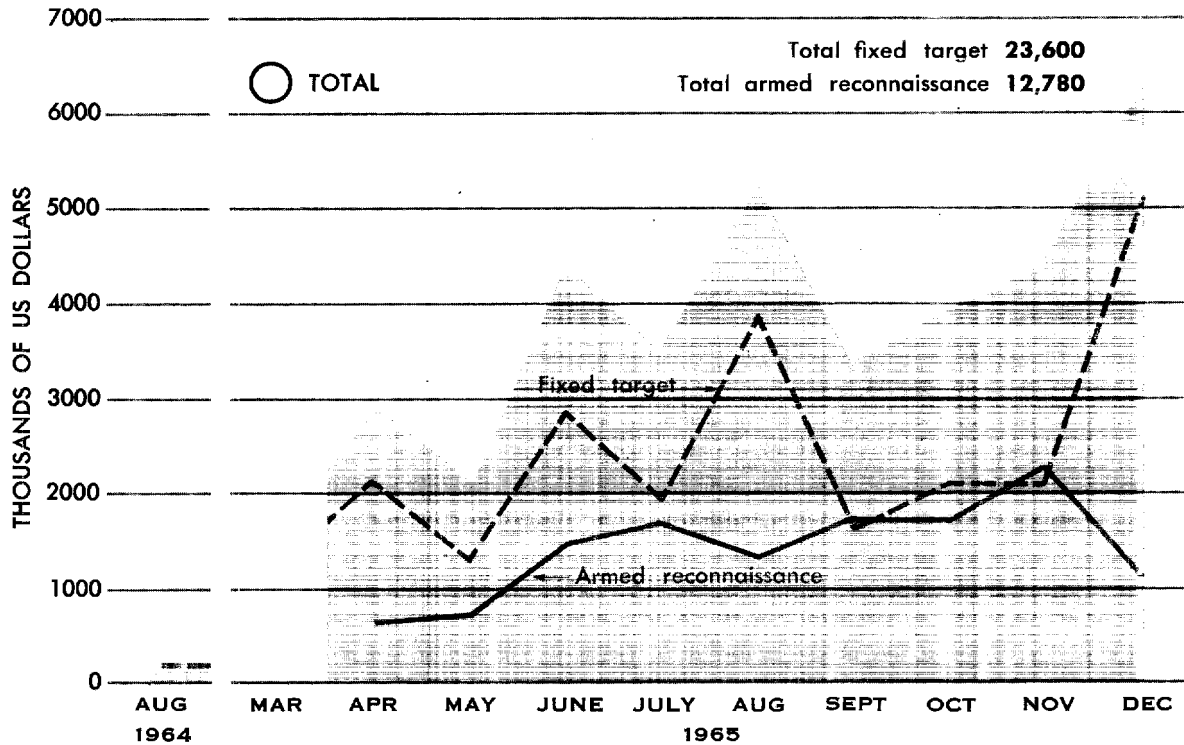
(MILLIONS OF US DOLLARS)



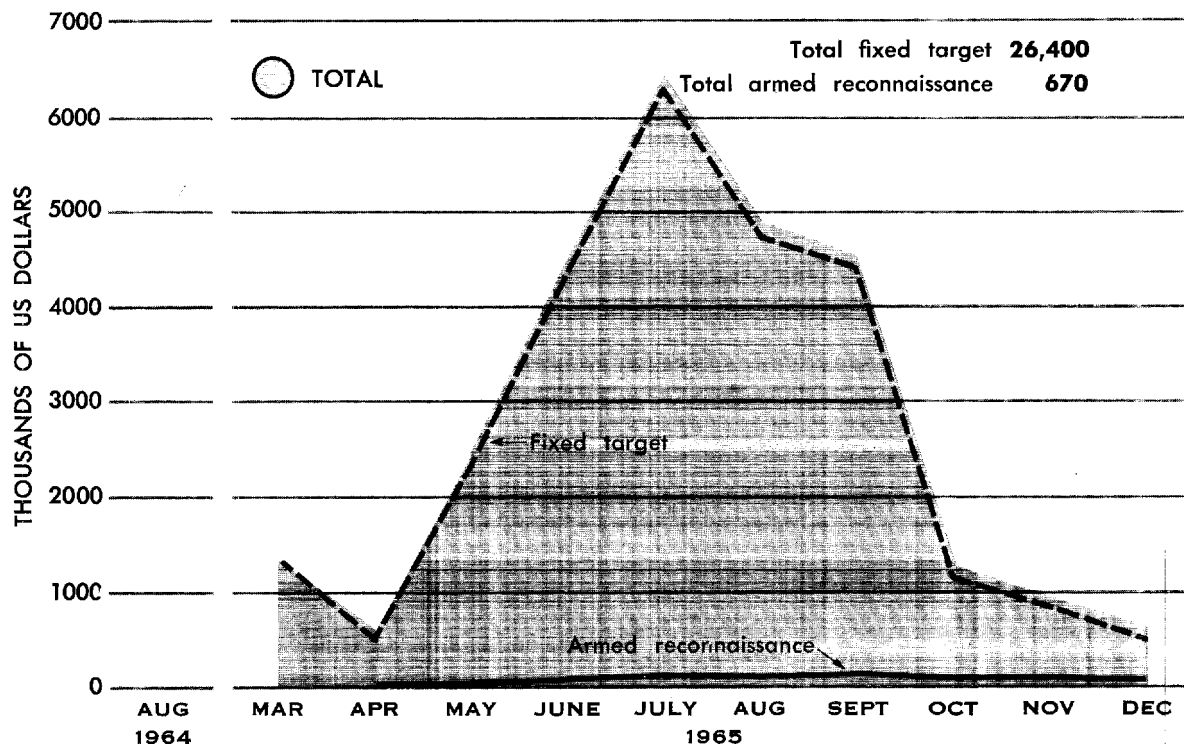
C-2 Value of Damage, by Sector, Inflicted on North Vietnam During the Rolling Thunder Program
61344

ROLLING THUNDER
Cost of Damage Inflicted

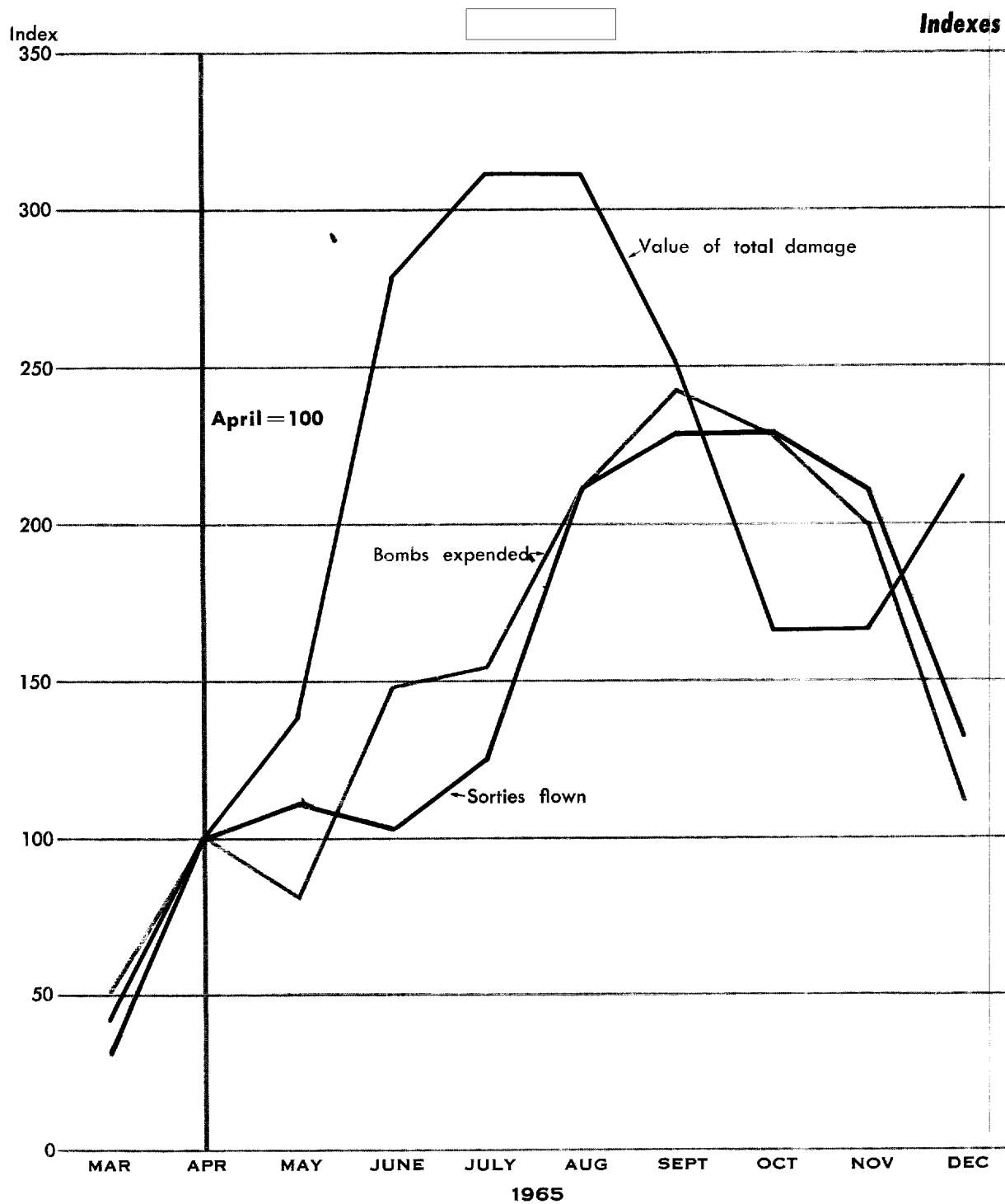
ECONOMIC DAMAGE (Including agricultural and export losses)



MILITARY DAMAGE



C-3,C-4,C-5 Total Cost to North Vietnam of Damage Inflicted During the Rolling Thunder Program



25X1

C-6 Rolling Thunder: Indexes of Value of Damage, Sorties Flown, and Bombs Expended

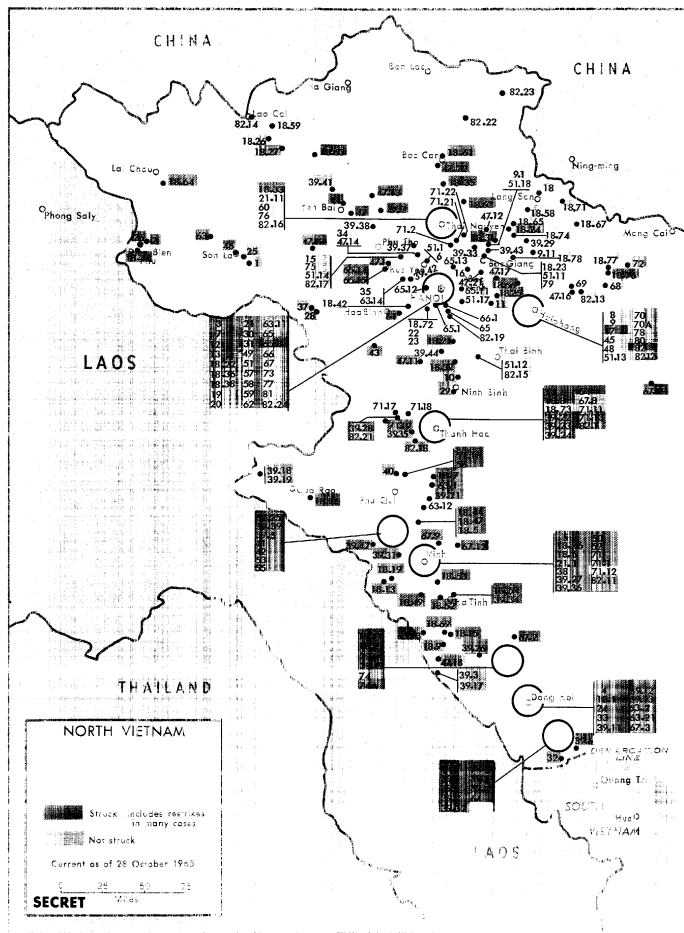
61348

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JCS Target Numbers deleted from latest listing:

Target Number	Name	Coordinates
	Quang Khe Highway Ferry West over the Rao Nay	17 42 42 N 106 26 50 E
	Vinh Highway Ferry over the Song Ca	18 38 40 N 105 42 35 E
	Muong Sen Highway Ferry over the Nam Mo	19 24 04 N 104 08 34 E
	Cay Giay Railroad Bridge over the Khe Bi	21 47 10 N 104 48 55 E
	Thai Nguyen Railroad Station Yards and Shops	21 33 31 N 105 51 05 E
	Cua Tung Highway Bridge over the Song Ben Hai	17 00 03 N 107 03 21 E
	Phu Doan Highway Bridge and Ferry over the Song Chay	21 38 41 N 105 11 10 E
	Suoi Rut Highway Ferry over the Black River	20 46 20 N 105 05 00 E
	Ban Kai Highway Ferry over the Black River	21 13 08 N 104 19 48 E
	Huu Hung Highway Ferry over the Kien Giang	17 24 00 N 106 38 50 E
	Phu Qui Highway Ferry North over the Song Hieu	19 20 00 N 105 25 35 E
	Vinh Son Highway Ferry over the Song Ca	18 53 55 N 105 17 51 E
	Phu Thach Highway Ferry over the Song Ca	18 34 35 N 105 39 42 E
	Trai Hoi Highway Bridge over the Ngan Sau	18 21 37 N 105 37 00 E
	Ron Highway Ferry over the Song Ron	17 52 30 N 106 26 45 E
	Xuan Son Highway Ferry over the Song Troc	17 36 51 N 106 19 10 E
	Mi Le Highway Ferry over the Dai Giang	17 19 24 N 106 37 44 E
	Phu Qui Highway Ferry over the Son Hieu	19 19 15 N 105 25 45 E
	Thuong Dinh Railroad/Highway Bridge over the Lech Truong	19 51 02 N 105 48 22 E
	Bai Thuong Army Barracks Complex North	20 05 01 N 105 26 01 E
	Vit Thu Lu Army Barracks and Storage Area	17 01 10 N 106 38 40 E
	Vinh Army Barracks Central NE, and Headquarters Military Region IV	18 40 22 N 105 41 15 E
	Hoa Lust Nam Army Barracks	17 10 30 N 106 49 20 E
	Hon Gio Military Barracks Area, Ile du Tigre	17 09 34 N 107 20 05 E
	Quan Lan Army Barracks	18 54 48 N 105 25 10 E
	Xom Y Lanh Army Barracks	17 48 03 N 105 46 57 E
	Tuyen Quang Ammunition Storage Area, Tin Vu	21 46 10 N 105 11 12 E
	Hanoi Petroleum Products Storage Area, Bac Mai	20 59 55 N 105 50 45 E
	Cap Mai Radar Site	18 07 00 N 106 25 25 E
	Ha Tinh Radar Site	18 19 20 N 105 55 05 E
	Quang Khe Radar Site	17 42 22 N 106 29 39 E
	Kim Cuong Radar Site	18 32 10 N 105 11 25 E
	Bai Thuong Radar Site	19 52 00 N 105 21 00 E
	Anh Son Radar Site	18 55 00 N 105 17 00 E
	Vinh Radar Site	18 43 00 N 105 40 00 E
	Thanh Hoa Radar Site	19 48 00 N 105 47 00 E
	Xom Lam Radar Site	20 50 00 N 104 45 00 E
	Thai Nguyen Radar Site	21 36 00 N 105 50 00 E
	Trai Ngau Radar Site	21 27 00 N 105 39 00 E
	Son La Radar Site	21 19 00 N 103 55 00 E
	Do Son Radar Site	20 41 00 N 106 49 00 E
	Dien Bien Phu Radar Site	21 19 00 N 103 01 00 E
	Na San Airfield Radar Site	21 13 00 N 104 01 00 E
	Nam Dinh Radar Site	20 27 00 N 106 10 00 E
	Phuc Yen Radar Site	21 19 00 N 105 50 00 E
	Dong Hoi Radar Site	17 30 00 N 106 36 00 E
	Vinh Linh Radar Site	17 05 00 N 107 07 00 E
	Lang Mo Radar Site	17 10 00 N 106 22 00 E
	Cua Lo Radar Site	18 50 00 N 105 40 50 E
	Bai Thuong Dam on the Song Chu	19 53 34 N 105 22 51 E
	Vinh Son Dam on the Song Ca	18 54 30 N 105 18 00 E
	An Lac Check Dam, on the Kien Giang	17 15 00 N 106 44 50 E



C-7 North Vietnam: Major JCS Target Struck and Not Struck During 1965

APPENDIX D

POTENTIAL OF AIR ATTACKS AS A WEAPON
TO ACHIEVE ROLLING THUNDER OBJECTIVESI. Military Significance of North Vietnam

The military significance of North Vietnam is measurable in terms of three basic functions which it performs in support of the military activities in South Vietnam. It serves (1) as a logistic base for the stockage and movement of supplies into South Vietnam, (2) as a source of manpower, and (3) as a control center for the direction of insurgency.

A. The Logistic Base

The North Vietnamese economy, which is basically one of subsistence agriculture, has only a small modern industrial sector concentrated in a few urban centers, including Hanoi, Haiphong, Nam Dinh, Viet Tri, and Thai Nguyen. The country imports little food even in poor agricultural years and depends largely on domestic production to feed its population of about 18 million persons. More than 80 percent of the labor force is engaged in agriculture, which in 1964 accounted for almost one-half of the gross national product (GNP). North Vietnam produces only minor items of military equipment -- grenades, mines, mortars, and ammunition for small arms -- and must import all of its heavy military equipment and most of its small arms, ammunition, and medical supplies from Communist countries.

The capabilities of North Vietnam's armed forces have not been affected significantly by attacks on economic and military facilities in North Vietnam. Although the movement of personnel, equipment, and supplies has been hampered by damaged transportation facilities, the Viet Cong and North Vietnamese forces place little direct reliance on the North Vietnamese economy for material. Within South Vietnam the Viet Cong have developed an effective logistic system which is able to procure from internal sources almost all of their requirements for supplies. The major items of critical material supply -- arms and ammunition, technical equipment, medical supplies -- are all items which North Vietnam itself does not produce. The main role of North Vietnam in obtaining these supplies is as an importer from third countries, usually Communist, and as a forwarder to South Vietnam through a well-developed supply system. North Vietnam has established and controls the following principal supply routes: (1) a land corridor through Laos; (2) a sea route from points in North Vietnam to points in the southern and coastal parts of South Vietnam; and (3) a route from Cambodia using both land and inland water routes to South Vietnam or on occasion resorting to sea infiltration. The overwhelming share of these supplies is funneled through North Vietnam or transported along the roads and trails in Laos.

B. Manpower

A major aspect of North Vietnam's military significance to the fighting in the south is its capacity both to train and to supply insurgent Viet Cong personnel for later infiltration into South Vietnam and to provide substantial increments of its own population to serve in South Vietnam or in indirect support functions.

North Vietnam has a population of over 18 million. Most of the labor force is engaged in agriculture and is seasonally underemployed, but because of the difficulty in shifting manpower to meet the requirements for the large number of new tasks resulting from bombing, labor supplies are tight. The regime views the manpower situation as "critical," and a large-scale mobilization of manpower has reportedly been under way in North Vietnam during 1965.

The country has about 4 million males of draft age, almost all of whom have been put in the regular armed forces, paramilitary organizations, or labor repair and maintenance battalions. In addition to these manpower resources, about 175,000 males reach draft age each year, of which at least 100,000 will be physically fit for military duty. With these resources the North Vietnamese should be able to sustain and probably increase the approximately 20,000-man rate of infiltration into South Vietnam maintained during 1965.

It is estimated that as many as 23, but probably only 12, of the 38 army infantry regiments in North Vietnam would be used to train infiltrates. These 12 units, operating on a four-month training cycle, could train and infiltrate the equivalent of nine North Vietnamese battalions each month during 1966, or a total of approximately 54,000 men for the year. This estimate of North Vietnamese capability to infiltrate forces into South Vietnam is a gross rate only. The net additions to be made to the Communist forces in South Vietnam will depend, in addition to decisions on the rate of infiltration, on the capability of the Viet Cong to train new and replacement troops and the casualty rates inflicted on Viet Cong and North Vietnamese forces during the year. On the basis of present projections, North Vietnam would account for more than 56 percent of the forces to be added to combined Viet Cong and North Vietnamese strength in 1966.

In addition to its ability to train and infiltrate significant numbers of North Vietnamese forces for service in South Vietnam, North Vietnam has also demonstrated a capacity to mobilize large numbers of personnel for activities involved in supporting the insurgency in the South. The diversion of manpower to tasks associated with dispersal programs, emergency repair, and construction and maintenance of lines of communication throughout North Vietnam may require the full-time services of 200,000 workers (equivalent to about 10 percent of the nonagricultural labor force) and the part-time impressment of another 100,000. An additional 150,000 persons are also obligated, on a part-time basis, to serve

[REDACTED]

in various aspects of civil defense which take them away from their normal pursuits. These levies represent a significant share of the labor force and an admitted cost to North Vietnam in supporting the war in the South. This problem does not yet seem to have reached a critical point.

C. Control Center for Insurgency

The function of North Vietnam as the control center for Viet Cong insurgency is well documented in intelligence materials. These materials confirm that North Vietnam is playing a vital role as a center from which the Viet Cong obtains vital support in the form of manpower, training, organization, and supplies. The Party and government leaders of North Vietnam also function as the source of political direction and, indeed, inspiration for the Viet Cong leaders.

The major instrument of political control and direction of the Viet Cong insurgency is the Lao Dong Party, specifically the Committee for the Supervision of the South which is attached to the Party's Central Committee. The Communist Party of North Vietnam has in effect as its southern branch, the People's Revolutionary Party of South Vietnam. This organization is responsible for providing funds for the Viet Cong war effort and of providing most of the essential nonmilitary goods for the Viet Cong organization. It also controls a wide array of Party, front, and military elements which implement the principal tasks of supporting the insurgency.

Although the North Vietnamese Communist Party and government have avoided any direct and overt ties with the National Liberation Front (NLF), the linkage is close and clear. Hanoi maintains control over the NLF through the Communist leaders in South Vietnam to whom North Vietnam issues overall guidance. This control channel runs from both the Reunification Department of the Central Committee and the Reunification Commission of the North Vietnamese Council of Ministers, both of which are headed by Nguyen Van Vinh. The North Vietnamese military command is also highly integrated into the hierarchy which directs the insurgency in the South.

The infiltration routes through Laos and into the three northernmost provinces of South Vietnam apparently are under North Vietnamese control.

[REDACTED]

25X1



II. The Logistics Target System

A. Interdiction Efforts During 1965

About 2,700 strike and flak suppression sorties carrying approximately 3,400 tons of ordnance were flown against JCS-designated fixed targets on LOC's in North Vietnam during 1965. All but about 5 percent of the total sorties and tonnage on the logistic target system were directed against 44 railroad, highway, and combination railroad and highway bridge targets selected from among the 63 JCS-targeted bridges.* The remaining JCS targets attacked on the LOC's included one railroad yard of the five targeted and two ports and one waterway lock of the total of 16 waterways targets as follows: 6 ports, 8 locks, and 2 mineable areas. The accompanying map showing JCS targets, divided by those attacked and not attacked, indicates that most of the JCS targets attacked on the LOC's were located south of Ninh Binh. Relatively few were located on the railroads and roads north and east of Hanoi.

In addition to scheduled strikes against JCS-designated targets, armed reconnaissance was planned to be a very significant part of the program for interdicting the LOC's. Within the areas of North Vietnam that are authorized for armed reconnaissance, not only JCS targets but also all other transport facilities, including roads and rail lines, ferries, fords, port facilities, transport equipment, and landing beaches, are targets. Coastal and inland water craft are considered to be targets only if they can be identified as possibly carrying military cargo.

B. Effect of the Interdiction Efforts

In general terms, it can be concluded that these interdiction efforts made it more difficult and expensive for North Vietnam to continue operating at somewhere near its normal economic level and to support the war in South Vietnam and Laos. Performance by the modern transport system during 1965 probably was not reduced below the level achieved in 1964. Performance would have considerably exceeded the 1964 level had it not been for the comparative success of attacks on the railroad line to Lao Cai. On the other railroad lines and roads the amount of interdiction, in terms of number and type of target and frequency of attack, was not enough to reduce the capacity of the routes below the level of traffic normally moved. It was believed during the planning stages for Rolling Thunder that destruction of bridges would reduce the capacity of the LOC's in the southern part of the country by about two-thirds and by even more in the north. Experience now indicates that the North Vietnamese have sufficient

* Two bridges have been deleted from the 63 targeted and 44 attacked, but all the data available for the bridges are analyzed in this Appendix.

recuperability that the reduction of route capacity by two-thirds is sustained only for a very short period of time if at all. The North Vietnamese are using a sufficient number of engineers and laborers to maintain routes in the southern part of the country at roughly two-thirds of their original capacity and at the same time to increase the number of routes and bypasses, thus making the network less vulnerable to attacks. Furthermore, the reduction actually achieved has not lowered the capacity to anywhere near the low level of traffic that normally moves on these routes. These conclusions are borne out by an analysis of specific routes and areas.*

The relative success in interdicting the Hanoi - Lao Cai rail line is explained by several factors. The Hanoi - Lao Cai line is used normally at two-thirds of capacity, a moderately heavy rate of utilization. At this rate of utilization this line becomes a rather attractive interdiction target, particularly in the absence of alternative means of transportation. There was no road paralleling the interdicted portions of the railroad, and the Red River which parallels the line at a distance of several miles has only limited navigability. Thus alternative modes of transport were not available over which the normal rail traffic could be moved and over which supplies to repair the rail bridges could be moved. Interdiction of through traffic was maintained by making fairly frequent attacks on a number of small bridges and one major JCS-designated bridge. The interdiction would have been even more successful in stopping all traffic were it not for the rapidity with which bridges were repaired, even though the line was being re-struck. The Lang Bun bridge, a two-span 150-foot steel bridge, was restored in late September or early October in 20 days or less, and after the second strike in October it was rebuilt in less than 11 days. In some instances the minor bridges on this line, ranging in length from 30 to 90 feet, were restored to service in less than eight days. The JCS estimate of the effort required to sustain interdiction of this rail line was placed at six strikes per month, each with 25 strike and 25 support sorties, or a total of 300 sorties. Data are not available at present to determine how many sorties were flown over this line, but it was apparently considerably less than the recommended number. Even if strikes had occurred once every five days, it is believed that bridges could have been returned to service, based on the demonstrated ability of the Communists to repair or replace damaged railroad bridges of up to 90 feet in length in 48 to 72 hours.

In the area south of Thanh Hoa the North Vietnamese have put forth great effort to maintain their existing routes. A comparison of the estimated capacities based on photography of 26 segments of route in January 1966 with capacities as of April 1965 indicates that on 15 segments the route capacity was maintained at the same level, on nine segments the capacity was reduced, and on two segments the capacity had actually increased. Two of the segments for which capacity is believed to have remained the same were sections of route 1A just north and south of Vinh, routes that have been heavily bombed.

* For transportation routes in Vietnam and Laos, see the map in Appendix A.

[redacted]

On most of the nine segments with reductions in capacity, the reduction amounted to 25 percent or less. Segments that had a reduction of more than 25 percent in capacity were routes 1A just south of Thanh Hoa (reduced from 3,800 tons to 1,350 tons each way per day*) and a portion of route 8 (reduced from 1,100 tons to 700 tons each way per day). In these instances it is quite obvious that the North Vietnamese did not need to use the road at even these reduced capacities. Increases in capacity occurred on route 1A from Ha Tinh south to the Demilitarized Zone (from 750 tons to 850 tons each way per day) and on route 103 near the Demilitarized Zone (from 50 to 150 tons each way per day), even though both of these routes have been heavily bombed because they are used as routes for men and supplies moving to the trail network for infiltration around the Demilitarized Zone.

The North Vietnamese construction of new and improvement of alternate routes has also been significant in maintaining the southward flow of supplies in spite of route interdiction. During 1965, more than 400 kilometers of alternate land routes and bypasses in Military Region IV were constructed. Improvement of the inland waterways in the area has also increased the flexibility of the network and increased capacity through certain areas. For example, the improvement of route 74 to serve as an alternate to route 1A and to bypass the Vinh area will make Vinh even less of a chokepoint.

Although data on actual levels of traffic moving on specific routes are generally scarce, [redacted] the traffic level is usually well below the capacity of the routes. Route 15 north of Tan Ap had an estimated capacity of 800 tons each way per day before bombing and 600 tons after bombing. In October, [redacted] only about 50 tons per day were moved to the Tan Ap area by truck on route 15. Paralleling this section of route 15 are an inland waterway, which delivered about 35 tons per day in October, and a makeshift rail line, which reportedly delivered about 15 tons per day. Had inland water and rail transport not been available, route 15 probably would have been used to transport the additional 50 tons moved by these modes, thus raising the traffic level to 100 tons per day, a level which is still well below its capacity. From Tan Ap, it is believed that most of the supplies have been moved by truck on route 15 through Mu Gia Pass. The capacity of route 15 from Tan Ap to Mu Gia is estimated to have been reduced by bombing from 600 tons to 450 tons each way per day. Traffic counts on the roads in Laos leading south from Mu Gia Pass indicate that traffic probably has amounted to an average of less than 100 tons per day since the beginning of the current dry season.

25X1

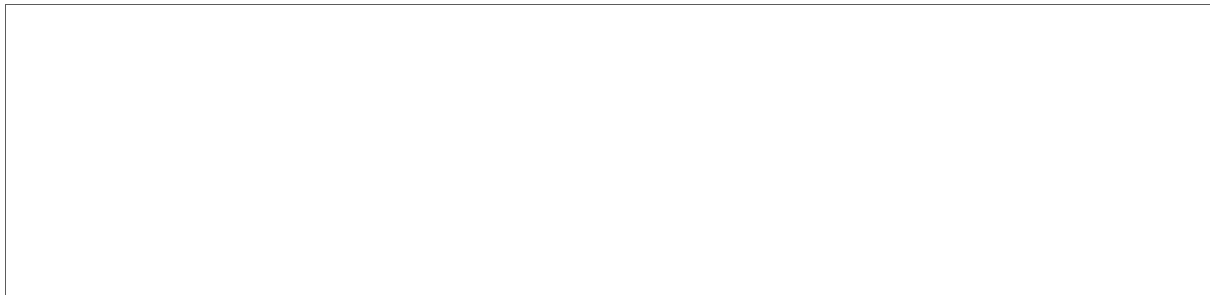
25X1

Examples are also available to indicate the extent to which interdiction of rail and water routes in the south was not sustained.

* Only dry season capacities are used in this section.

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25X5

The prime examples of this situation are JCS target [] the Thanh Hoa railroad/highway bridge, and target [] the Dong Phuong Thuong railroad/highway bridge, both located in the Thanh Hoa area. Target [] was first struck on 3 April with the recommended tonnage and was severely damaged. Comparatively light restrikes were made twice in May, once each month in June and July, and twice in September with no significant new damage. At the end of September the bridge was serviceable for rail and truck traffic. Target [] was destroyed on 3 April also. Small amounts of ordnance were dropped on the target in May and June, causing further damage. A new bypass bridge under construction upstream was noted in photography in early September. The old bridge was restructed in September but not the new bridge. By early November the new bridge was completed and operational. The demonstrated speed with which the North Vietnamese can replace or repair destroyed or damaged bridges requires that restrikes be scheduled frequently, as often as once every three days, against bridges under repair or against alternate facilities under construction. Even this action will not prevent the nighttime construction and use of fords and ferries at the bridge site.

25X5

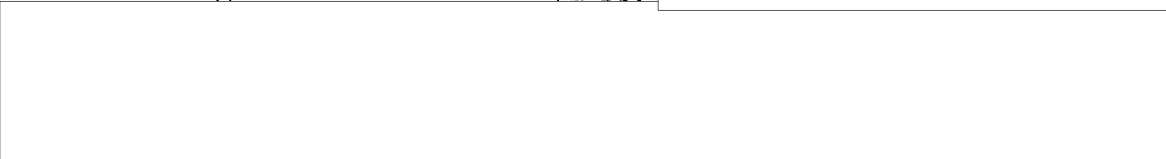
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The initial strike in June 1965 on the port of Ben Thuy was reported to have destroyed 50 percent of the maritime traffic capability of the port, estimated to have been more than 700 tons per day. A number of restrikes were carried out in June and July, resulting in additional damage to warehouses and piers. []

25X1

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[] There are additional indications during January that large barges and lighters were being towed to Ben Thuy from the Haiphong area by seagoing tugs on a regular basis.

C. Effort Required to Further Reduce the Capacity of the LOC's

The experience of US bombing in other countries indicates the probable success to be expected from interdiction of transport systems and the effort required. The lessons learned from the bombing of Germany and Japan during World War II and of North Korea during the Korean War are summarized below.

25X1

1. Germany

Although the aerial war against Germany began in earnest about 1942, only in 1944, two years later, did the effect become noticeable in reducing the munitions output of the German economy. The bombing of the ball bearing and aircraft industries seemed to have little effect on the war, but the bombing in 1944 of the petroleum industry and transportation network late in the year appears to have dealt a severe blow to the German war effort. The rapid decline of all sections of the German economy after December 1944 was the result of numerous factors and, therefore, cannot be attributed to the bombing alone. The transportation system might well have been able to deliver the necessary military goods to the front had the economy not failed because of other reasons. The real lesson of the German air war was the importance of careful target selection.

2. Japan

Only one-fourth of the tonnage of bombs used by the Allied Forces in the Pacific War were dropped on the home islands of Japan. Although the Japanese economy suffered a severe blow when the islands were bombed in 1945, the overall effects of these attacks are difficult to assess because the loss of merchant shipping had already essentially isolated Japan from its sources of industrial raw materials. Japan's economy was neutralized as a result of this isolation by the time that heavy aerial bombardment began. Japan's internal transportation network was not subjected to substantial attack and remained in reasonably good operating condition at the time of its surrender.

3. North Korea

The war in Vietnam is teaching the same lessons learned during the Korean War. One of these lessons is that it is very difficult to prevent by aerial bombing the movement of military supplies. In North Korea, it appeared that the movement of large amounts of supplies required by the Chinese Communist and North Korean troops -- estimated at from 2,400 to 3,000 tons a day -- could be prevented by aerial bombing. However, the enemy not only continued to move the minimum amount required for his daily resupply but in addition moved in another 800 tons a day to build up stockpiles. The daily supplies estimated to be needed by the Viet Cong and North Vietnamese now fighting in South Vietnam are less than one-half of one percent of those required by the Chinese Communists and North Koreans during the Korean War -- about 12 tons a day moving to South Vietnam, compared with about 2,400 to 3,000 tons required in the earlier war. It appears that a much greater aerial bombing effort would be required to stop the present movement of supplies, a trickle compared with the large flow that moved during the Korean War. Yet the number of sorties flown over North Vietnam in the Vietnamese War through December 1965 was less

than one-third of the number flown during a comparable period in the Korean War. The total ordnance dropped on North Vietnam in 1965 was also only one-third that dropped on interdiction targets in Korea during Operation Strangle alone. In both wars the Communists have shown a remarkable ability to improvise repairs, build bypass lines, mass workers to maintain and repair essential supply lines, and move supplies in the dark.

D. Recent Experience in Laos

Even more applicable to the present problem is the experience gained from recent bombing over Laos. During the period of the bombing lull in North Vietnam, attacks on targets and routes in Laos were increased over earlier levels, amounting to about 9,000 sorties, some 8,000 of which were flown over the Panhandle area south of Nape Pass. These sorties each dropped an average of two tons of ordnance. The majority of the sorties over the Panhandle were directed over the main supply routes to South Vietnam, route 12 and its bypass from Mu Gia Pass and connecting routes to the south -- 23, 911, 92, 922, 96, and 165. Nevertheless, the level of truck traffic moving south on routes 23 and 911 averaged 29 trucks per day -- twice the average of 15 trucks per day moving south in this area during the same period one year earlier. On 28 December 1965, as many as 115 trucks moved south on route 911 in one day, indicating that the average level of truck traffic probably could have been much higher if the Communists had wanted to move more supplies south.

The trucks generally travel at night to avoid detection. The aircraft have revealed comparatively few trucks on the road by dropping flares. Pilots of the fast-flying aircraft even have trouble locating the routes because they are over the area only a short period of time. The dense natural tree cover and excellent camouflage techniques used to conceal the roads, truck parks, and the comparatively few bridges, fords, and ferries on the routes have resulted in very few targets being available for bombing. It is quite possible that the bombs have been expended on suspected targets rather than identified targets. The improved earth surfaces of the roads are easily repaired if cratered, and during the dry season truck traffic can ford most streams when the bridges are destroyed. Construction material is readily available from the forest beside the road to make whatever repairs are necessary. During the rainy season, flying conditions are poor, and traffic can move in the daytime under cloud cover. Some of the traffic is moved by inland waterway rather than by truck in the rainy season. During the coming rainy season, road conditions will undoubtedly be poor, but it is probable that sufficient improvements in the routes have been made to provide an all-season route through the Panhandle.

The Laotian experience resembles that in the southern part of North Vietnam in that the volume of traffic needed to be moved is only a small volume of military traffic. If the routes in these areas had to support a civilian economy as the German transport system did, they could be carrying traffic of sufficient volume to show some interdiction results from airstrikes. Only when the routes are being used at near-capacity levels can attacks that damage bridges, crater roadbeds, and force traffic to move at night be effective. It is hardly conceivable that conventional air interdiction of the land routes in North Vietnam and Laos could be so numerous, widespread, and repeated that the North Vietnamese would decide that the effort required to move supplies by land to South Vietnam was not possible.

E. The Requirement for Successful Interdiction

Analysts who have examined this problem say that it is impossible to decide what might be required to interdict given transport routes to produce a specific reduction in capacity. The experience of 1965 in attempting to sustain interdiction against a rudimentary transport system moving only small amounts of supplies would indicate that the extreme difficulty in obtaining reductions in capacity to desired levels would require an inordinately high level of sorties and ordnance expenditure. Although continued attacks against traffic moving in the southern areas of North Vietnam and Laos would be justified, the optimum return would probably be realized by concentrating, in combination with attacks on other target systems, the interdiction program on the logistic target systems in the northern part of the country.

A logistic target system that is proposed in an intensified allied air offensive to interdict land transport in northern North Vietnam includes attacks on 29 major bridges and the four principal railroad yards and shops. The initial strikes against these targets would require an estimated 1,760 strike and support sorties and 1,500 tons of ordnance. A precise restrike effort required to keep these targets interdicted has not been calculated, but it would include armed reconnaissance on a 24-hour basis and a combined, sustained effort of over 3,000 sorties a month against land transport targets. An interdiction program only against the two rail connections to China -- the Hanoi-Lao Cai and Hanoi-Dong Dang lines -- would require an estimated 750 strike and support sorties monthly. This program, if effectively implemented, should stop through traffic on major routes. More intensive attacks would be necessary to halt the use of these routes for shuttle service, and this objective may not be completely feasible. Attacks on these 33 land transport targets, the major portion of which are located on the more heavily used transport routes of the country, would be much more effective in reducing the flow of supplies than attacking minor bridges in the south and in other outlying areas. From the standpoint of target identification, this program would be more easily carried out than attacks on the more obscure, smaller, and diverse transport targets in the south.

A major interdiction attack against logistic targets would achieve optimum results if it were combined with the mining of the three major ports. The mining program would require initially 104 sorties and 190 tons of ordnance. The closing of the ports to oceangoing traffic would throw almost all of North Vietnam's import traffic onto the rail connections to China. The Hanoi-Dong Dang line would then be operating at or close to full capacity. If other essential import requirements were generated by attacks on industrial facilities, such as the Haiphong cement plant, import traffic requirements would then exceed the capacity of the rail line. With only limited highway capacity available, interdiction of northern transport lines would then have a more immediate and direct impact. The flow of military supplies into North Vietnam and onward to South Vietnam would be slowed up and made more costly. Some economic imports would probably have to be foregone. In summary, the North Vietnamese regime would by this program be brought under far stronger pressure from air attacks than that obtained by the pattern of airstrikes in 1965.

It appears that air interdiction with the weapons available and at the level of sorties flown in 1965 will place no real restraint on the level of Communist activity in South Vietnam until their requirements for resupply are much higher than now estimated. It is concluded that to stop the flow of supplies by land from North Vietnam to South Vietnam, allied forces must physically occupy the Panhandle of Laos and completely control a belt across the northern part of South Vietnam. Even then the North Vietnamese would not be at the end of their options and could undertake alternative means of resupply such as sea infiltration or increased use of routes through Cambodia.

F. Some Probable Limits to Resupply

There should be some multiple of the level of air attacks, however, that would increase the cost to the regime and place an upper limit on the level of support that it would be willing to maintain. In order to maintain the supply lines and support the logistic effort in 1965, it is estimated that at least 200,000 full-time laborers and 100,000 part-time workers were required. This number is equivalent to about 20 percent of the industrial labor force. Most of these workers probably come from the agricultural sector, but even their diversion could have an unfavorable impact on agricultural production, particularly in a country where food is in short supply. If this diversion of labor has to increase substantially additional quantities of food would have to be imported to make up for production foregone. This not only would cause increased internal distribution problems but also would aggravate the entire import program, particularly if the major ports were closed by mining and the rail connections to China were subjected to heavy interdiction.

One of the key determinants in the effectiveness of the interdiction effort is the level of supplies required by the Communist forces in South Vietnam. As these requirements increase, the interdiction efforts have a greater chance of success. As allied offensive operations increase in South Vietnam, the Communists will be forced to fight more and will thus use supplies at a higher rate. This will also be true if they on their own initiative try to step up the pace of the fighting. At the same time, if sweep operations uncover and destroy stockpiles of weapons and ammunition the Communist forces will be forced to depend to a larger extent on the flow of supplies from external sources. If the operations in South Vietnam could impose a total dependence on external sources for supply, the daily external logistic requirement would be six times the present level. This requirement could be satisfied through the existing supply network. If, however, the Communist forces build up to the force levels projected for the end of 1966, fight at intensive levels of combat, and are completely dependent on external sources, the North Vietnamese would be hard pressed to meet total requirements through land routes alone.

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III. The "Will of the Regime as a Target System"

In North Vietnam, three main factors appear to affect the determination of the regime to continue to support the war in South Vietnam: (1) the course of the war itself in the South; (2) the degree of political and material support rendered the regime by its two main allies, the USSR and Communist China; and (3) the economic, social, and political consequences within North Vietnam itself of supporting the war in South Vietnam. The effort required in supporting the war in South Vietnam draws very little on the physical resources of North Vietnam. The neutralization of given target systems within North Vietnam does, however, exact an increasing cost as the price to be paid for supporting the insurgency. This Appendix examines the various target systems within North Vietnam, with the exception of lines of communication, ranks them in a rough order of their importance to the military effort, presents a judgment on the feasibility or desirability of subjecting them to air attack, and evaluates the probable impact of recommended attacks. Estimates of the forces and ordnance required are presented only for those target systems which it is believed currently offer defensible and fruitful choices in attaining the objectives of the Rolling Thunder program.

A. The Military Supply Target System

Even assuming that the field commanders will have the authority to neutralize all military target systems which prevent control of North Vietnam's airspace, there remain valid military supply and military/economic target systems. The destruction of these targets would compound the adjustment problems which the North Vietnamese have had to face in countering the attacks from the 1965 Rolling Thunder program.

In the North Vietnamese military supply system there are 15 troop barracks, 5 ammunition depots, and 6 supply and ordnance depots designated as fixed targets by the JCS which have not been attacked (see Table D-1). These facilities primarily support North Vietnamese military activity in the North; nevertheless, a number of these facilities also serve as training areas for Viet Cong forces and are supply points for North Vietnamese and Viet Cong forces operating in South Vietnam.

The effectiveness of the postulated attack on these facilities will depend on the extent to which they are in fact in active use. The Hanoi regime appears to have abandoned or dispersed some facilities of this type into the countryside where they will be less vulnerable to air attacks. The dispersion of troops and the abandonment of barracks has been quite widespread. Because construction of temporary storage facilities for ammunition and ordnance may be more difficult in North Vietnam's tropical climate, the extent of their dispersion is less certain and probably less widespread.

Table D-1

Military Supply Target System

JCS Target Number	Name	Estimated Sorties			Ordnance Requirement (Tons)	25X5
		Strike	Support	Total		
Barracks						
	Xuan Mai SSW	44	24	68	99.0	25X1
	Xuan Mai NNW	28	24	52	63.0	
	Ha Dong Barracks/Supply Depot	100	32	132	225.0	
	Vinh Yen North	46	20	66	103.5	
	Son Tay SW	34	20	54	76.5	
	Kep Ha NE	64	28	92	144.0	
	Trai Thon	24	16	40	54.0	
	Vinh Yen NNE	26	20	46	58.5	
	Phu Tho NW	18	16	34	40.5	
	Ngoc Thai	18	16	34	40.5	
	Son Dong SSE	54	16	70	121.5	
	Kep South	20	16	36	45.0	
	Chi Ne	18	16	34	40.5	
	Bien Son NNE	132	20	152	297.0	
	Nom Son	8	8	16	18.0	
Ammunition depots						
	Haiphong	76	28	104	114.0	25X5
	Vinh Yen	32	20	52	48.0	
	Hon Gai Explosives Storage	28	12	40	42.0	
	Cam Ly	24	20	44	36.0	
	Bac Giang	20	16	36	45.0	
Supply/ordnance depots						
	Hanoi South	28	24	52	21.0	25X5
	Hanoi North	30	20	50	22.5	
	Thai Nguyen North	14	20	34	10.5	
	Van Dien	16	20	36	12.0	
	Van Dien Vehicle Depot	58	32	90	43.5	
	Son Tay	34	24	58	25.5	
Total		994	528	1,522	1,846.5	

On balance, destruction of these targets would impede the flow of material in the military supply system and would disrupt military training programs in North Vietnam, but it does not appear likely to decisively cripple the military effort of the regime. The effects would be even more disruptive if other recommended attacks against military/economic targets and lines of communication were carried out. These added attacks would greatly complicate but still not eliminate the flow of essential military supplies into North Vietnam and their eventual distribution to military consumers.

B. The Military/Economic Target System

The economic targets in North Vietnam's modern industrial base which have a direct bearing on the regime's ability to support the war in the South are the major bulk petroleum storage facilities and the Haiphong cement plant (see Table D-2). The petroleum storage installations are vital to maintaining supply and distribution activities within North Vietnam and through Laos, to the mobility of North Vietnamese military forces, and to distribution and transport services for the civilian economy. The Haiphong cement plant as the sole producer in North Vietnam provides a major input to both normal construction activity and the intensive reconstruction and repair programs necessitated by Rolling Thunder attacks.

1. Petroleum Storage Facilities

Previous airstrikes against bulk petroleum facilities destroyed or rendered useless four storage facilities which represented about 37,000 tons of bulk storage capacity. The estimated expansion of airstrikes against eight major storage terminals would deprive the regime of an additional 165,000 tons of capacity. There would remain only 4,000 tons of residual capacity in two of the four bombed sites and some 10,000 tons of storage dispersed in a variety of untargeted locations, including some 2,200 tons in small buried tanks at seven newly identified dispersed storage facilities. Thus the planned attacks would eliminate the principal bulk petroleum terminals in North Vietnam and would preclude the delivery of petroleum supplies in bulk by tankers. About 90 percent of North Vietnam's imports of petroleum currently are delivered by tanker.

A minimum of 440 sorties, comprising 280 strike and 160 support aircraft, will probably be required to destroy the eight major facilities. Losses resulting from the air defenses protecting these targets are estimated at about 3 percent, or 13 aircraft. The ordnance requirement for these targets is estimated to be about 850 tons.

In 1965 the total supply of petroleum, all imported, was about 175,000 tons. Although coal is the principal source of primary energy, this amount of petroleum probably represents North Vietnam's minimum essential needs. In relation to normal monthly rates of consumption, North Vietnam's storage capacity represents almost a year's

Table D-2
Military/Economic Target System

JCS Target Number	Name	Capacity (Metric Tons)	Estimated Sorties			Ordnance Requirement (Tons)
			Strike	Support	Total	
Petroleum storage facilities <u>a/</u>						25X5
	Haiphong	72,000	58	24	82	196.0
	Hanoi (Thanh Am)	34,000	36	24	60	121.5
	Phuc Yen	14,000	50	24	74	169.0
	Duong Nham	14,000	38	20	58	85.5
	Nguyen Khe	13,000	40	20	60	135.0
	Do Son	8,000	22	12	34	49.5
	Bac Giang					
	(Phu Lang Thuong)	6,000	20	16	36	45.0
	Viet Tri	4,000	20	20	40	45.0
Total		<u>165,000</u>	<u>284</u>	<u>160</u>	<u>444</u>	<u>846.5</u>
Cement plant						
	Haiphong	700,000 to 800,000	4	16	20	13.5

a. Previous strikes at four facilities have eliminated almost 37,000 tons of capacity.

supply. Therefore, if the attack is to obtain optimum effect, it is imperative that it be carried out almost simultaneously on all petroleum storage targets. Simultaneous attack insures the most certain way of eliminating the cushion represented by excess storage capacity and stocks and thus creating a critical shortage of supplies to meet essential requirements. The loss of petroleum storage facilities -- and their contents -- would have an immediate effect on the economy. The effect on normal industrial production activities would be slight because most of the industrial enterprises in North Vietnam rely on coal or electricity for energy. Consumption of petroleum by individual civil consumers is negligible. The major effect in the civilian economy would be in transportation. Civilian motorized transportation would come to a quick halt if imports of petroleum were interdicted continuously. The transport of food, raw materials, and finished goods would be curtailed drastically. Relief would be found only to the extent that priority transport and distribution problems could be handled by primitive means of transport or through use of existing stockpiles.

A sustained loss of petroleum storage facilities coupled with an inability to import even minimum operating requirements would have its greatest effect on military operations. North Vietnamese military forces account for about 60 percent of total petroleum consumption, or a monthly average of about 8,500 tons. North Vietnam with Chinese cooperation would probably be able to maintain petroleum imports at almost normal levels even after the intensified attacks discussed in this Appendix. Therefore, the supply of essential imports of petroleum for military requirements would appear to be almost certain.

Nevertheless, the attack would compound the difficulties of maintaining the flow of civilian and military imports on the land transport connections with Communist China. The difficulties would be increased as attacks on other target systems increased the traffic flows in these land and coastal water transport routes.

2. Haiphong Cement Plant

An attack on the Haiphong cement plant would neutralize North Vietnam's only producer of cement and create a major impediment to reconstruction and repair programs at least in the short run. Over the longer term, cement could be imported from Communist China. The import requirement could be in the order of 700,000 to 800,000 tons a year and would require a doubling of the present volume of all seaborne imports. If the cement and all seaborne imports had to be carried on the rail line from China, the total traffic volume would be in excess of the normal capacities of the Hanoi-Dong Dang rail line and the highway connections to China and would be far in excess of their capacity under conditions of interdiction.

C. The Modern Industrial Target System

The modern industrial target system of North Vietnam consists of those major facilities which cumulatively represent Hanoi's hopes for economic development and growth. However, excluding those military and military-related industrial facilities and the fertilizer plants which contribute directly and solely to agricultural output, the bulk of the modern industrial facilities contribute in only a minor way to the maintenance of the war effort.

Hence, modern industry has been called a "hostage target system" in the sense that, while its destruction could well have a considerable psychological impact on the Hanoi leadership, its output is not essential for the continuation of the insurgency in the South and is only indirectly related to the maintenance of military defense in the North.

Such an attack is often postulated on the ground that by depriving Hanoi of almost all of its modern economy and the major hallmarks of its economic progress the regime will be persuaded to enter into negotiations to end the war. This outcome is uncertain and probably unlikely. North Vietnam's modern industrial economy makes almost no direct or significant contribution to the war effort which is sustained materially almost exclusively by supplies from other Communist countries. Since North Vietnam is essentially a subsistence economy, the industrial sector also makes only a limited contribution to economic activity. The loss of industrial production would have almost no impact on the great mass of this agrarian society. The small element of the population directly affected would hardly be sufficient, or disposed, to persuade the regime to stop the war. For these reasons an attack on the modern industrial base of itself would not be likely to attain US objectives.

The experience of the Korean War also supports this judgment. Korea in 1950 was a country with a population considerably smaller and an industrial base much larger than that of North Vietnam in 1965. Most of Korea's modern industry was destroyed in the first three months of the war. One year later, hydroelectric plants were attacked to increase pressures on the regime. Attacks in the spring of 1953 against irrigation dams brought further pressure on the Korean economy. This carefully phased program failed to force the enemy to accept UN truce proposals. In both North Korea and North Vietnam it is clear that the modern industrial base is too small to serve as a testing ground for the "hostage" concept of industrial destruction as a means of deterring aggression.

Attacks on modern industrial facilities, however, would become potentially more promising when and as the effect of other actions -- the war in the South and the results of other Rolling Thunder programs -- gave a cumulative indication of effective pressure upon the regime. At this time an extension of the Rolling Thunder program to attacks on these facilities could add significantly to the psychological pressures influencing the regime's attitude toward negotiations.

There are three categories of plants which fall within the general classification of modern industrial facilities. These are the electric powerplants, the newly constructed heavy industry facilities, and a variety of factories which produce civilian-type goods for the most part. Because these plants are only indirectly related to the military effort, none of them is recommended for priority consideration as targets at this time. They are discussed briefly below.

1. Electric Power

The electric power facilities which would be the object of the postulated attacks are the thermal powerplants at Hanoi, Thai Nguyen, and Hon Gai, and the Dong Anh transformer substation which feeds power from three sources to the city of Hanoi. In addition, the thermal powerplants at Viet Tri, Haiphong city, the Haiphong cement plant, and Lao Cai would also become inoperable (see Table D-3). Destruction of these facilities, including those destroyed so far, would raise the total loss of power-generating capacity to 160,000 kilowatts, or 91 percent of national capacity. These strikes would bring modern industry in the affected areas to a virtual halt and would severely disrupt the highly electrified operations at the port of Cam Pha.

Among the major industrial installations that would probably be shut down are the Hanoi machine building plant; the Hanoi rubber products plant; the Nam Dinh textile plant; the March 8 textile plant; the Thai Nguyen iron and steel plant and iron ore mines; the Hon Gai coal mines; the paper mill, chemical combine, and sugar refinery at Viet Tri; the Haiphong cement plant and phosphate plant; and the Lao Cai apatite mines.

If the attacks on the electric power facilities were effectively executed, the North Vietnamese would be hard pressed to restore power to the degree necessary to resume industrial production. Destruction of the targeted power facilities would also deny to agriculture an estimated 30 to 40 percent of the power supply now used in agriculture. The country lacks both the capability to manufacture the required equipment and the technical skills necessary to reconstruct the powerplants.



2. Heavy Industry

As noted earlier, successful air attacks on the 8 remaining electric power facilities in North Vietnam would eliminate the power sources for 13 major industrial facilities and, as a result, would bring most modern industrial activity in North Vietnam to a halt. Nevertheless, physical destruction of heavy industrial plant facilities could have considerable psychological impact on the regime. Both the time and resources required for reconstruction of these facilities -- in addition to the requirements for replacing damaged electric power facilities -- would further set back North Vietnamese

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Table D-3

Modern Industrial Target System

<u>JCS Target Number</u>	<u>Name</u>	<u>Capacity (Kilowatts)</u>
Electric power facilities <u>a/</u>		
	Hanoi Thermal Powerplant	32,500
	Thai Nguyen Thermal Powerplant	24,000
	Hon Gai Thermal Powerplant	15,000
	Dong Anh Transformer Substation	
	Viet Tri Thermal Powerplant	16,000
	Haiphong Cement Plant Thermal Powerplant	12,000
	Haiphong Thermal Powerplant	6,000
	Lao Cai Thermal Powerplant	8,000
Total		<u>113,500</u>
Heavy industry		
	Hanoi Machine Building Plant	
	Thai Nguyen Iron and Steel Plant <u>b/</u>	
	Viet Tri Chemical Combine <u>b/</u>	
	Tran Hung Dao Machinery Plant <u>b/</u>	
Light industry		
	Nam Dinh Textile Plant <u>b/</u>	
	Viet Tri Paper Mill <u>b/</u>	
	March 8 Textile Mill <u>b/</u>	
	Sao Vang Rubber Products Plant in Hanoi <u>b/</u>	

25X5

25X5

a. Previous strikes at 6 plants have eliminated more than 45,000 kilowatts of capacity.

b. This target would cease operations as the result of destruction of electric power facilities.

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plans for eventual industrialization. In this case, the following industrial targets would be subject to attack.

a. Hanoi Machine Building Plant

This modern plant, which was a key Soviet aid project, is highly prized by the North Vietnamese as a symbol of advanced technology.

b. Thai Nguyen Iron and Steel Plant

This 100,000-ton steel mill, which is being built with Chinese aid, is the most expensive foreign aid project to be built in North Vietnam. The plant is already producing pig iron and was expected to be producing crude steel and some rolled products by the end of 1965.

c. Viet Tri Chemical Combine

This new plant, built by the Chinese and East Germans, is the center of the industrial chemicals industry in North Vietnam.

d. Tran Hung Dao Machinery Plant

This plant is the second largest machinery and equipment producer in North Vietnam.

3. Light Industry

The following are the major light industry targets of North Vietnam:

a. March 8 Textile Mill

This plant, which has the capacity to produce 30 million meters of cotton fabric annually, was built with Chinese aid and began operation in 1964.

b. Sao Vang Rubber Products Plant in Hanoi

This Chinese-built plant is the sole producer of rubber products. Output includes "large" automobile tires (1965 plan: 23,000 units) of 8 types, including truck tires. It also produces some 30 products for the communications industry as well as bicycle tires, inner tubes, recap tires, and shoe products.

c. Nam Dinh Textile Plant

This plant -- the largest producer of cotton fabric in North Vietnam -- was reconstructed in 1956 and subsequently expanded with Chinese Communist aid.

d. Viet Tri Paper Mill



This plant was built with Chinese aid and has a capacity of 20,000 metric tons. The plant began initial operation in 1961.

D. The Command and Control Target System

A traditionally attractive target system in any intensified air campaign is the command and control system used by the political, military, and governmental control organizations. The central control targets in North Vietnam are located in the Hanoi sanctuary area, in the built-up northeastern portion of the city (see Table D-4). Developments since the start of the Rolling Thunder program, which are discussed below, in combination with the features of North Vietnam's basic communications system make the predictable outcome of an attack in the control and command system debatable. Moreover the probability of a high rate of civilian casualties resulting from mass attacks on major control and command centers would probably provoke a hostile reaction in other world capitals. For these reasons, this course of action is not recommended at this stage of the conflict.

Table D-4

Command and Control Target System

<u>JCS Target Number</u>	<u>Name</u>
Command	
	Hanoi North Vietnamese Air Defense Headquarters Hanoi Ministry of National Defense Party-Government Building Complex, Hanoi
Control (Communications)	
	Hanoi International Radio Transmittal Station at Dai Mo Hanoi High-Frequency Communications Station at Phu Coc Hanoi International Radio Receiving Station at Son Dong Hanoi Radio Broadcasting Complex at Me Tri

25X5

25X5

The North Vietnamese command and control system has already been modified in response to the air attacks of 1965. This program plus contingency planning against further attacks and the relatively primitive level of development of North Vietnamese telecommunications raise some question as to whether the system can be rendered inoperable.

Over the past year, both party and government authorities at the national level have encouraged officials at the lower provincial and district levels to minimize the number of problems referred to the central level for decision. The central authorities have had only mixed success in this program, but it seems probable that local authorities in North Vietnam now have larger responsibilities than previously and that the implementation of policy at the lower levels has become less dependent on communication with the central authorities. Attacks against the central headquarters of party, government, and military authority would now seem less likely to cause confusion and disruption than might have been the case before the air attacks of 1965.

The attacks postulated in this Appendix on other fixed targets near urban areas would probably eliminate the wireline transmission network which serves as the primary transmission system in North Vietnam. This wireline system, which is operated by the Directorate of Posts and Telecommunications (DPT), is paralleled by an independent but less extensive wireline network operated by the North Vietnamese Army and reserved for military use. Joint use of the same wireline poles by both networks in many areas and their parallel nature suggests that both systems would cease operation soon after they were attacked. In this case, even heavier reliance would be placed on the regime's high-frequency (HF) radio communications.

Currently the Hanoi government maintains about 40 primary and several hundred secondary HF radio stations throughout the country which make communications possible on about 1,200 circuits. With the beginning of the Rolling Thunder program in 1965, North Vietnam turned increasingly to HF radio transmission, almost certainly because of bomb damage inflicted on open wirelines but probably also because of a heavier traffic load. A special network that was created and put on standby in 1964 began in the spring of 1965 to handle overflow traffic from the DPT open wireline system. In the fall of 1965, at least two additional networks, totaling about 40 radio stations, were newly activated to serve road and rail construction and repair units.

The overwhelming majority of North Vietnam's HF radio stations are extremely limited in transmission capacity, usually to one voice channel or a single manual Morse circuit. They possess the advantages, however, of small size and a high degree of transportability; they are thus difficult targets for destruction from the air.

The principal users of HF radio facilities (as well as the open wirelines) are the DPT, the Lao Dong (Communist) Party, and the North

Vietnamese Army. Smaller but nevertheless important HF networks operate independently to serve the specialized needs of the aeronautical, maritime, and meteorological services. A large HF radio facility located at Dai Mo serves as North Vietnam's principal means of long-distance, international communication.

The major HF radio installations and arterial open wireline routes in North Vietnam are highly vulnerable to physical destruction from the air. Of prime importance are the HF radio installations serving the Central Executive Committee and Armed Forces High Command at Phu Coc, the international transmitter site at Dai Mo, the international receiving station at Son Dong, and the radiobroadcasting complex at Me Tri. The most important wireline routes are those radiating from Hanoi to Haiphong, to Thanh Hoa, and to the Chinese and Laotian borders.

A sustained high level of unrestricted bombing attacks against North Vietnam would be a serious but not insurmountable blow to the country's telecommunications base. Under such circumstances, military, economic, and political management in North Vietnam itself would become progressively more difficult, and command and control of Viet Cong forces would be strained. Nevertheless, the widespread use and deployment of HF radio facilities gives the North Vietnamese telecommunications system an inherent resiliency. Most of these smaller radio facilities can be operated by diesel-powered generators. Petroleum requirements for their operation undoubtedly have high priority, are small relative to the needs of other petroleum consumers (for example, transportation), and are likely to be met even under terms of the escalated attacks postulated in this Appendix. Although intensive and selective bombing of major wireline routes would produce at least short-run communications disruptions in key areas, North Vietnam's HF radio facilities afford a practically irreducible base of telecommunications capability.


E. The Agricultural Target System

The agricultural target system that has been considered falls into two categories (see Table D-5). The first is the industrial

facilities which directly support agricultural output and which consist primarily of fertilizer plants and one sugar refinery. The other segment of the target system that has been considered is the breaching of the levee system on the Red River delta. The potential vulnerability of North Vietnamese crops to direct attack by chemical agents or plant pathogens has not been considered.

Table D-5

Agricultural Target System

<u>JCS Target Number</u>	<u>Name</u>
	Lam Thao Superphosphate Fertilizer Plant
	Ha Bac Nitrogenous Fertilizer Plant (Bac Giang)
	Haiphong Phosphate Plant
	Viet Tri Sugar Refinery
	Van Diem Sugar Mill

25X5

The North Vietnamese economy is basically one of subsistence agriculture. The country imports little food even in poor agricultural years and depends largely on domestic food production to feed its population. More than 80 percent of the labor force is engaged in agriculture, which in 1964 accounted for almost one-half of the gross national product (GNP). The bulk of this population lives on food produced, processed, and stored locally. A relatively small shortfall in agricultural production resulting from air attacks could aggravate an already tight food situation in view of the increased food requirements generated by the expanded war effort.

1. Industrial Plants

Neutralization of industrial (largely fertilizer) plants affecting the food supply in North Vietnam would not add significantly to North Vietnam's problem in feeding its population. Damage to the targeted fertilizer plants would result in a maximum reduction in annual output of rice -- totaling 4.5 million to 4.7 million tons in recent years -- of 50,000 tons. In addition, North Vietnam would be deprived of the 225,000-ton increase in annual production of rice which would result from the additions to total capacity for production of chemical fertilizer that are scheduled to go into operation during 1966. Destruction of the sugar refinery would have a negligible

effect on the food supply. Domestic production of sugar, equalling about 2 kilograms per capita annually, provides only an average of 21 calories in the daily North Vietnamese diet, and currently unused capacity at smaller, untargeted facilities could be used to compensate for the loss of the large plant.

2. The Red River Delta Levees

Another segment of the potential agricultural target is the levee system in the Red River delta. In order to inflict maximum damage to the rice crop -- the staple food in North Vietnam -- these levees would have to be breached at some point in the period mid-July to mid-August when the Red River is at its height. During this period, the level of the Red River -- contained by an extensive system of levees -- is considerably above the level of the surrounding plain. Also during this period, the newly transplanted fall rice seedlings, which normally produce about two-thirds of the annual rice harvest, are most vulnerable to damage.

The areas most vulnerable to flooding if the primary levees of this system were breached are the Ha Dong area southwest of the Red River and the Ha Bac area northeast of the river. A secondary system of levees in these areas has tended to confine the damage from major floods in the past to roughly 200,000 hectares,* or almost one-quarter of the total area. Breaching of the secondary levees could substantially increase the acreage flooded. If only the main levees were breached, it is estimated that the crop loss would be on the order of several hundred thousand tons of rice -- or less than 10 percent of the average annual harvest in recent years. If the secondary levees were also effectively breached, the decrease in rice production could reach three-quarters of a million tons.

Successful breaching of these levees would also affect the one and one-half million people in this area, which includes the city of Hanoi. Furthermore, most of the industrial, commercial, and military activity in Hanoi and its suburbs would be temporarily halted until the water receded.

Four factors -- the short time when the attacks on the levees must be executed, the need for great precision in bombing a small target, possible North Vietnamese countermeasures, and the probable adverse public reaction in the West -- detract from "levee busting." As regards the timing of the attacks, they must be mounted within the one-month period from mid-July to mid-August when the river is highest -- above 33 feet -- and the fall rice crop is most vulnerable to flood damage. Within this time period, the attack should follow an unusually high flood stage (the historic highs of the river in flood at Hanoi have been just under 39 feet) because the heights of the primary levees run from 42 to 49 feet.

* One hectare is equal to 2.471 acres.

As for the factor of precision in bombing, the objective is to create a series of overlapping craters across the entire crown of the levee (a distance of approximately 80 feet when the river is at the 33-foot stage) the lips of which are below the water level in the river. If achieved, the scouring action of water rushing through the breach would rapidly deepen and widen the break. A suggested means of creating the series of overlapping craters is with trains of 1,000-pound general-purpose bombs consisting of 11 bombs each which penetrate about 10 feet in average soil and produce craters about 37 feet in diameter. The following tabulation shows three assurance levels of cutting the levee when the river is at the 33-foot level:

<u>Percent Assurance</u>	<u>Number of Trains</u>	<u>Number of 1,000-Pound General-Purpose Bombs</u>	<u>Tonnage</u>
50	5	55	27.5
70	6	66	33.0
85	8	88	44.0

These assurance levels apply only to one breach; from two to four separate and almost simultaneous breaches are probably required to achieve the type and extent of flood damage discussed above. Breaching the levees at one point requires heavy bomb loads and accurate delivery; breaching them at multiple points at the same time is likely to be even more difficult. The existence of heavy antiaircraft defenses in the same general area that the levees can be most effectively attacked further compounds the difficulty.

As regards countermeasures, the North Vietnamese are well aware of the importance of the levee system to life in the Red River delta, and the regime has maintained and strengthened the system over the years. The existence of a secondary system of levees, which are not here considered as targets for air attack, tends to limit the effects of breaching the primary system. Well before the initiation of US air attacks in 1965, discussions within the North Vietnamese regime of the importance of the levee system highlighted the success of the Viet Minh in countering the effects of French destruction of levees and dams and suggests that past experience has in part prepared the regime for such an eventuality. One obvious method of countering the effects of a breach in the levees in the target area is to deliberately breach a number of the levees upstream and divert the water into less important agricultural areas. Defensive breaching of this type could rapidly drop the level of flood water at Hanoi by as much as six feet. A specific illustration of the sensitivity of the North Vietnamese regime to possible attacks on levees was contained in a recent report which mentioned the collection of barrage materials in the Hanoi area to fill breaches in the levees.

Loss of life, homes, and places of work would be exceedingly disruptive to the social order in the affected areas in the short run but over the long run, the effect on rice availabilities would probably be the hardest problem for the regime. The loss of several hundred thousand tons of rice, particularly in a year of below-average harvests, would force the regime to seek outside sources of supply. Communist China, which in an average year produces 75 million to 85 million tons of rice, could provide the necessary amount. Under conditions of continuing air interdiction of the land links between North Vietnam and Communist China, transport of such supplies could be difficult. The factors of timing, bombing difficulty, and North Vietnamese counter-measures all argue against attempting to breach the levees; similarly, the regime would be quick to exploit the political advantage provided by such attacks.

F. The Manpower Target System

North Vietnam is an essentially agrarian society with less than 15 percent of the population living in urban areas. Of the more than two million urban population, 928,000 are concentrated in the eight largest cities and their populations are as follows:

	<u>Population</u>
Hanoi	475,000
Haiphong	210,000
Nam Dinh	90,000
Vinh	46,000
Thanh Hoa	35,000
Thai Nguyen	28,000
Viet Tri	26,000
Dong Hoi	18,000

Area bombing attacks of the type mounted against Japan in World War II could be mounted against these cities. Civilian casualties in Japan were about 600,000 (excluding those from atomic weapons), or a ratio of about 4 casualties per ton of bombs. Most of the tonnage was dropped on urban areas in Japan. Several factors suggest that such attacks against North Vietnamese cities would not necessarily result in as high a proportion of casualties as those resulting from the attacks against Japan. Unlike the very high proportion of wooden structures in Japanese cities, brick and masonry construction is a common feature of North Vietnamese cities. Traditional Asian methods of construction with wood and fibres tend to be seen chiefly on the outskirts of the larger cities of North Vietnam and do not predominate except in the smaller towns and villages. Because of their construction, North Vietnamese cities do not appear to be as vulnerable to incendiary attack

and fire damage as were Japanese cities. Furthermore, differences in the layout of North Vietnamese cities further decrease their vulnerability to bombing damage. For example, the system of wide boulevards which compartment the city of Hanoi and the network of canals which runs through Haiphong city constitute fairly effective firebreaks. Other examples of differences in urban layout are Thai Nguyen, in which the two main built-up areas are separated from one another by a few miles of rice fields and scattered dwellings, and Viet Tri, in which several built-up areas are dispersed along the banks above the junction of two rivers.

There are also good indications that the regime's civil defense program is more effective than the Japanese program in World War II. Partial evacuation of the larger North Vietnamese cities has already been undertaken as was the case in Japan prior to the attacks in the spring of 1945. However, the early warning system of North Vietnam and its shelter programs in the cities appear to be better conceived and, during the attacks of 1965, better carried out than was the case in Japan. Finally, the regime has made it clear to the North Vietnamese people that they must expect air attacks -- at least some of the casualties in Japan are credited to the government-sponsored belief that serious bombing attacks could never occur.

For these reasons, it is believed that casualties (the total of killed and wounded) in attacked areas of North Vietnamese cities are likely to be less than was the case in Japan.

Under conditions of continuing industrial activity, bombing attacks on urban areas would probably have the greatest effect on North Vietnam's limited supply of skilled manpower. Approximately 85 percent, or about 255,000, of North Vietnam's supply of skilled manpower lives and works in the eight cities considered as targets. Roughly 150,000 of this total is concentrated in two cities -- Hanoi, about 105,000, and Haiphong, 45,000. Qualitatively, the manpower loss to the regime from these air attacks would be most severe in the Hanoi-Haiphong area since the concentration of the more advanced industrial facilities in this area means that the most highly skilled among the labor force are likely to become casualties.

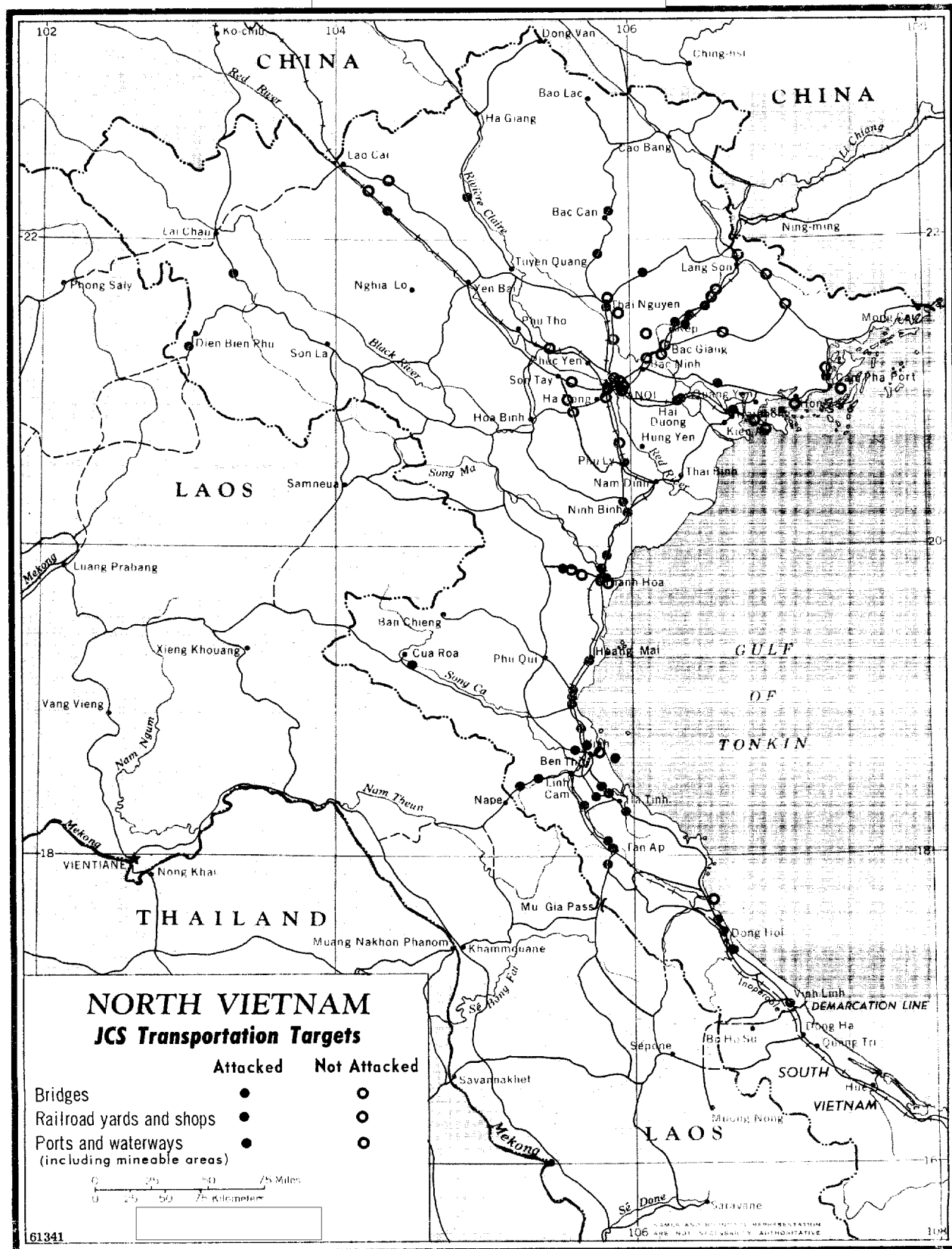
Extensive physical damage would also result from these attacks and a large proportion of surviving urban population would evacuate to near-by rural areas. In the short run, the organizational effort necessary to reallocate most of the urban labor force in addition to implementing further defense measures and the necessary adjustments in the agricultural labor force would strain the limited management capabilities of North Vietnam's cadre force. Much of the manpower made available to the regime would be wasted through irrational assignments, and many urban workers would probably be left to their own devices long enough to scatter into sparsely populated areas where an

inadequate control system would make it almost impossible to channel them into essential jobs. The existence of the fairly efficient and resilient communications system and a reasonably well-disciplined Vietnamese Workers Party apparatus of around 900,000 members would be prime assets in the regime's attempts to solve this problem. Nevertheless, the morale of the nonagricultural labor force would probably decline with a consequent lowering of its potential productivity due to numerous casualties, transfers from normal jobs, separation from families, and the probable demand for further amounts of uncompensated labor.

Medical services in North Vietnam are inadequate to meet the nation's normal public health needs. These services, therefore, can provide only minimum emergency care and treatment of additional civilian casualties. The small numbers of civilian medical and paramedical personnel (estimated to include 1,400 physicians, 2,300 doctors' assistants, and 8,000 nurses in 1965), most of whom are poorly trained, are unable to cope with the high incidence of nutritional, infectious, and parasitic diseases. They presumably have been hard pressed to service the relatively few war casualties sustained thus far. The civilian and military hospitals (only 25,000 beds), convalescent homes, and village medical stations are, with few exceptions, poorly equipped and chronically overcrowded. Moreover, with the exception of several important combat-related items, medicines are in short supply. The exceptions are mainly penicillin, blood plasma, and sulfa drugs, large stocks of which have been accumulated as a result of greatly increased imports during the past year. The stockpile of penicillin is estimated to be sufficient, according to US experience, to meet the needs of more than 800,000 troops in active combat for one year.

It has not been possible in the time available to arrive at an estimate of the bomb tonnage required to bring the eight leading cities of North Vietnam under air attack. Nor was an estimate made of the probable level of casualties. Clearly, heavy attack on these cities would result both in severe physical damage as well as widespread casualties, particularly if the attacks were concentrated in time. The major reason for giving skilled manpower a lower target priority at this time is that of the probable adverse effects of such attack on Western opinion while a large number of industrial and military targets remained intact. The manpower attack is one which, by its very nature, is attractive as a "last ditch" effort, after other target systems have been generally neutralized and the regime nevertheless continues to press on with the conflict.

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D-1 North Vietnam: JCS Transportation Targets Attacked and Not Attacked

APPENDIX E

THE EFFECTIVENESS OF AIR ATTACKS IN OTHER WARS

The United States has engaged in three previous wars in which air power has played a major role as a means of conducting offensive warfare. This Appendix analyzes the role of air power in the air wars against Germany, Japan, and North Korea. The analysis of the air wars against Germany and Japan treats in general terms the overall economic effects of the air war campaign with somewhat more detailed treatment of the attacks on transportation. The air war against Korea is most similar to the air war being conducted in North Vietnam. For this reason the Korean War is examined in considerable detail to evaluate the attempts to interdict North Korea's transport system and to evaluate the lessons this experience may have for the Rolling Thunder program.

I. The Air War Against GermanyA. The German Economy

The German war economy benefited greatly from the German buildup in industrial activity which took place between 1933 and 1939. While both England and the United States entered World War II with substantial unemployment, the German labor force was fully employed by 1939. Six years of rising output (1934-39) meant that substantial investments were made in expanding plant facilities, both for heavy industry and for armament production. One result was that the German armament industry, with few exceptions, worked only single shifts throughout the war and the great reserve capacity available from double or triple shift operations not only gave considerable flexibility but also cushioned the effects of Allied air attacks. In 1938, approximately 30 percent of the national product was already devoted to war expenditures, and this level rose very slowly until, by the end of 1944, approximately 50 percent of the national product was channeled into war purposes.

The output of civilian consumption goods, after the restrictions in the initial war years, was reasonably well maintained so that civilian standards of living continued to be comfortably above the levels of the depression years of the early 1930's.

Germany's dependence on imported raw materials was always looked upon as a classical weakness in wartime. The four-year plan of 1936 was aimed in part at overcoming the most serious of these weaknesses, chiefly through expanded production of synthetic oil, textiles, and rubber. However, Germany imported very substantial percentages of iron ore, copper, manganese, and other metals. Partly as a result of over-running other Western European sources of supply and partly as a result of substitution, Germany managed until well into 1944 to avoid serious

embarrassment from shortages of imported war material. The Germans found that consumption of many materials, such as copper, traditionally believed to be essential to armaments production could be drastically cut without materially affecting the quality or the usefulness of the end product.

While electric power supplies became tight early in the war, rationing and curtailment of nonessential uses permitted priority needs to be met until 1944. During that year, certain major industrial consumers, such as aluminum producers, were deprived of supplies from time to time on a temporary basis.

In summary, the German economy proved surprisingly able to withstand substantial attacks and still increase munitions output until the weight of Allied bombardment increased to approximately 300,000 tons a quarter, which did not take place until late in 1944 (see Figure E-1).

B. Overall Economic Effects of Bombing

During 1942 and 1943 the overall effects of air raids on the German economy were small. The US Strategic Bombing Survey estimated that the total loss of German armament production resulting from air attacks carried out in 1943 was not more than 3 to 5 percent, even though the attacks required the Germans to call upon some of their reserves.

In the first four months of 1944 the US air forces concentrated their effort on aircraft plants and on antifriction bearing factories. The vulnerability of these targets proved smaller than had been expected. In May and June of 1944 the weight of attacks on Germany was reduced because of the diversion of a high proportion of the Allied air forces to preparation for the invasion that was launched on 6 June. The air offensive that started later, beginning with attacks on oil and nitrogen facilities and continuing against German transportation, achieved more noticeable results. Before the end of 1944 the output of aviation gasoline and nitrogen had fallen by 90 percent. The attack on transportation was a major factor in reducing the volume of car loadings by 75 percent within five months. However, the index of armament production stayed high. It reached a peak in the third quarter of 1944; the decline in the fourth quarter (from causes other than those attributable to territorial losses) was only about 5 percent.

The Allied bombing program did succeed in tying up a significant portion of the labor force by the third quarter of 1944. An estimated 4-1/2 million workers, or nearly 20 percent of the nonagricultural labor force, were engaged in debris clearance, reconstruction and dispersal projects, the replacement of goods lost through air raids, and in the manning and production of antiaircraft munitions. Air raid casualties reduced the labor force by no more than 500,000 to 700,000, or about 2 percent.

From December 1944 onward, all sections of the German economy were in a rapid decline. This was due to the results of bombing in combination with other causes, particularly the military reverses which had led to the invasion of Germany itself. In February 1945, Silesia and the Saar had been lost, and car loadings were only 11 percent of normal and still falling. The final land actions carrying the Allied armies across the Rhine and Oder Rivers were under way by the time the economy of Germany had ceased to be able to support significant military operations.

C. Target Systems

The greatest weight of Allied air attack, approximately 56 percent, was delivered against two target systems -- land transportation and industrial areas (see Table E-1). Transportation targets are discussed in D, below.

Table E-1

Distribution of Bomb Tonnages in the European Theater
During World War II

	<u>Percent</u>
Land transportation targets	32.1
Industrial areas	23.7
Military targets	11.1
Oil, chemical, and rubber targets	9.3
Airfields and airdromes	6.9
Naval and water transportation targets	4.2
V-weapon launching sites	2.0
Aircraft factories	1.8
Miscellaneous manufacturing targets	2.6
All other targets	6.3
Total	<u>100.0</u>

The attacks against industrial areas, generally identified as city area raids, were primarily the work of the Royal Air Force. It began its famous raids on German urban areas in 1942, with the first thousand-plane raid against Cologne. This was followed by heavy attacks on other industrial cities, the most noteworthy of which were the July and August strikes against Hamburg. The Hamburg raid destroyed about one-third of the residential housing and killed between 60,000 and 100,000 people. While this raid had an immediate shock effect, the city attacks prior to the autumn of 1944 did not substantially affect German war production. Recovery was

essentially achieved within a relatively few weeks; and because industrial plants were generally located around the perimeter of German cities, they were characteristically undamaged.

The heavy tonnages of bombs dropped on urban areas as a result of attacks on transportation and targets beginning in September 1944 produced more significant effects. However, since there were so many forces contributing to the collapse of production in the last six months of the war, it has not been possible to assess separately the effect of these later area raids on war production.

1. Civilian Morale

The conclusions of the US Strategic Bombing Survey with respect to the effect of Allied air attack on German morale are as follows:

The Survey has made extensive studies of the reaction of German people to the air attack and especially to city raids. These studies were carefully designed to cover a complete cross section of the German people in western and southern Germany and to reflect with a minimum of bias their attitude and behavior during the raids. These studies show that the morale of the German people deteriorated under aerial attack. The night raids were feared far more than daylight raids. The people lost faith in the prospect of victory, in their leaders and in the promises and propaganda to which they were subjected. Most of all, they wanted the war to end. They resorted increasingly to "black radio" listening, to circulation of rumor and fact in opposition to the Regime; and there was some increase in active political dissidence - in 1944 one German in every thousand was arrested for a political offense. If they had been at liberty to vote themselves out of the war, they would have done so well before the final surrender. In a determined police state, however, there is a wide difference between dissatisfaction and expressed opposition. Although examination of official records and those of individual plants shows that absenteeism increased and productivity diminished somewhat in the late stages of the war, by and large workers continued to work. However dissatisfied they were with the war, the German people lacked either the will or the means to make their dissatisfaction evident.

The city area raids have left their mark on the German people as well as on their cities. Far more than any other military action that preceded the actual occupation of Germany itself, these attacks left the German people with a solid lesson in the disadvantages of war. It was a terrible lesson.

2. The Attack on the Ball-Bearing Industry

The classic example of an attack on a so-called bottleneck industry was that of the German ball-bearing industry. Not only was ball-bearing production concentrated, with approximately half of the output coming from plants in the Schweinfurt area, but Germany was assumed to need a continuing full supply of ball bearings to continue war production.

Air attacks on Schweinfurt took place on 17 August and 14 October 1943. Losses to attacking German fighters (the plants were outside of escort range) were such that the attacks could not be maintained. During the next four months, when there was a bombing lull, the Germans took energetic steps to disperse the industry. This dispersal was aided by the fact that machine tools were relatively undamaged. Furthermore, it proved possible to eliminate very high percentages of the total number of ball bearings used in some equipment without materially impairing its operation for either civilian or military purposes. The Germans had also exercised the precaution of accumulating substantial stocks. From examination of the records in the ball-bearing industry, and from the testimony of war production officials, there is no evidence that the attacks on the ball-bearing industry had any measurable effect on essential war production.

3. The Aircraft Plants As a Target System

The abortive experience with the ball-bearing industry was followed by renewed attacks on the German aircraft industry. Earlier attacks had the effect of reducing the vulnerability of aircraft assembly plants because the Germans pursued a policy of subdividing and dispersing aircraft production facilities. The new attacks began in February 1944, with the protection of long-range fighter escorts, and were again aimed at aircraft assembly plants as opposed to aircraft engine plants. These attacks did not succeed in reducing the production of aircraft, probably because there was considerable excess capacity in the assembly phase of the aircraft industry and because, once again, relatively simple protective measures prevented serious loss of machine tools. Hence the attack on the ball-bearing industry and the attack on aircraft assembly facilities were proved to be errors in target selection. The German Air Force was defeated, but its defeat came largely as a result of combat operations by the Allied forces. Later in the

war the Ruhr steel industry was singled out as a target system, but because steel lies so deep in the industrial process there is no evidence that these attacks affected munitions production before the end of the war.

4. The Attack on the Petroleum Industry

The attack on the German petroleum industry began in a preliminary way with two strikes in May 1944. These attacks were not followed up, because of the almost complete diversion of air power to attacking tactical targets in preparation for and in support of the D-Day invasion.

The German oil position was tight throughout the war and was largely concentrated in 13 synthetic fuel plants. Although there were early attacks on the Rumanian petroleum industry, by August 1944 this source of supply was overrun by the USSR, and German dependence on the synthetic plants became almost complete.

By July 1944, every major plant had been hit. After the attacks began in May, production, which had averaged 316,000 tons per month, fell to 17,000 tons a month in September. Although there was a modest recovery in November and December, the post-attack output was only a fraction of the pre-attack level. Unlike the ball-bearing plants, the synthetic oil plants were attacked again when they were brought back into operation. For example, the largest plant, Leuna, was attacked 22 times by early 1945, and its output from the day of the first attack averaged only 9 percent of capacity.

The effects of depriving Germany of its major fuel resources were almost immediate in terms of military operations. For lack of fuel, pilot training was drastically curtailed, making German aircraft increasingly vulnerable to experienced Allied fighters. As the summer of 1944 wore on, the German panzer divisions were more and more seriously hampered by decreased fuel production. German military stocks of petroleum were so low that when the famous Ardennes offensive (the so-called Battle of the Bulge) was launched, German reserves of fuel were insufficient to support the operation. The German high command counted on capturing Allied stocks to keep the operation rolling. Finally, in February and March of 1945 the Germans massed 1,200 tanks on the Vistula to check the Russian advance. In very short order, the tanks were overrun because they had insufficient fuel for maneuver.

There were other dividends from the attack on the petroleum industry because 60 percent of the nitrogen and 40 percent of the methanol output came from the synthetic oil plants. Shortages of these essential chemicals for munitions were reflected in shortages of ammunition within a few months.

D. The Attack on Transportation

The German transportation system was dominated by the railroads. In combination, the state-owned and privately owned railroads handled three-quarters of all freight traffic and about 70 percent of passenger traffic. Most of the remainder of the freight traffic was accounted for by waterway (largely inland) carriers and less than 3 percent by highway vehicles. The rigid government regulation of trucks was designed to prevent the development of a highway truck system which would compete with the state-owned railways for long-haul business. Therefore, motor transportation was almost entirely limited to local and suburban service.

The rail system was well maintained and had general overcapacity on permanent way, with respect to both lines and classification yards. The inland waterways system connected the important rivers of North Germany, crisscrossed the Ruhr coal area, and provided through water transportation from the Ruhr into the Berlin area. The moderate expansion of the rail system during the war was concentrated in those few places where it was necessary to construct new yards in critical points such as Munich or to parallel vulnerable viaducts with bypass lines.

During most of the air war against Germany the bombing of rail transportation was not given a high priority. Although heavy major ground operations were preceded or accompanied by concentrated attacks on local rail facilities in or near the battle area, transportation was not then selected as a priority target system, because of its size and complexity. As a consequence, the railroads in Germany and the ports of the inland waterways system were subject to only sporadic attacks until the middle of 1944. Heavy attacks on transportation within Germany proper did not begin until September 1944. The recuperative powers of the system were such that until bomb tonnages exceeded 12,000 tons per month the repair system was able to cope with the damage.

At the same time that the heavy attacks were beginning on the railroads, successful attacks on four waterway targets substantially eliminated through traffic on the Rhine and North German canals. By 14 October the Rhine River was similarly interdicted at Cologne, and as a consequence the economic traffic of the important Ruhr district fell to about 12 percent of the level of October 1943-March 1944. By the end of December, car loadings had been decreased by about 40 percent and by the first week of March 1945 by almost 80 percent. The index of munitions production held up substantially better than these figures would indicate, largely because of stocks of components and subassemblies.

1. Inland Waterways

The general experience with the attack on waterways was that these were relatively successful in halting traffic -- often for a considerable period of time. Furthermore, there were frequent additive side effects such as that resulting from the mining of the Danube River.

The period of intensified mine laying in the Danube was from April to December 1944. The mines (and other aerial attacks) resulted in the sinking of over 40 percent of the Danube cargo fleet. Furthermore, there was a precipitous drop in morale because mine explosions often resulted in the loss of the crew. Consequently, desertions and delays because of manpower shortages were numerous. The tonnage handled on the river dropped about 60 percent within two months and continued to fall throughout the summer. Complete statistics are not available, but the Danube operation was clearly a highly successful one.

2. Railroads

The bomb tonnages dropped on land transportation targets in Germany were as follows, by quarter:

1944

January-March	1,650
April-June	8,250
July-September	19,200 <u>a/</u>
October-December	71,000

1945

January-March	105,000
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a. Of which 13,000 tons were dropped in September.

It can be seen from the above figures that until September 1944 the tonnages dropped were not sufficient to overwhelm the capabilities of the repair system. Following that date the weight of the attack increased sharply and in the first quarter of 1945 was 64 times that of the first quarter of 1944. The result was a progressive tieup of traffic.

Although coal traffic (about 40 percent of all the traffic carried by the German railroads) held up better than miscellaneous commercial traffic, the decline was both more easily traceable and more dramatic. The September raids reduced coal-car placements in the Essen Division of the Reichsbahn (the originator of most of the coal traffic of the Ruhr) to an average of 12,000 cars daily compared with 21,400 at the beginning of the year. Most of this was for consumption within the Ruhr. By January, placements in the Ruhr were down to 9,000 cars a day, and in February 1945 virtually complete interdiction of the Ruhr District was achieved. The German economy was powered by coal and, except in limited areas, the coal supply had been eliminated.

Military (Wehrmacht) traffic had top priority over all other traffic. During the period of attack this traffic came to account for an ever-increasing proportion of the declining movement. Through 1944 the air attack did not prevent the army from originating such movements, although the time of arrival, or even the arrival, of units and equipment became increasingly uncertain. Couriers accompanied detachments and even shipments of tanks and other weapons; their task was to get off the train when it was delayed and report where it could be found. After the turn of the year, even military movements became increasingly difficult. The Ardennes counteroffensive, the troops and equipment for which were marshaled over the railroads, was probably the last such major effort the Reichsbahn would have been capable of in the West.

II. The Air War Against Japan

At the outset of World War II the Japanese economy was relatively small, approximately 10 percent the size of that of the United States. Despite great efforts to increase the availability of raw materials from domestic sources, Japan was highly dependent on imports to maintain its industrial plant. The acquisition of Manchuria and parts of China helped materially in alleviating Japan's shortages of coking coal, iron ore, and foodstuffs, but negligible quantities of iron ore and bauxite were available within Japan's "inner zone." Plans to develop a synthetic oil industry failed to yield significant results, and Japan was almost wholly dependent on imports from the Dutch East Indies. The same overseas dependence existed for rubber, ferroalloys, and manganese as well as for a variety of other militarily important ferrous and nonferrous materials.

Japan's strategy had been based on the accumulation of munitions, oil, aircraft, and ships which could be thrown into action against essentially nonmobilized enemies. The expectation was that the devastation of the initial blow would result in the enemy suing for peace.

A. The Air Attacks Against Japan Proper

Most of the tonnage of bombs dropped by Allied forces in the Pacific War fell outside the Japanese home islands. Only one-fourth, or 160,000 to 170,000 tons, was dropped on Japan proper, mostly by B-29's. In contrast, 1,360,000 tons were dropped within Germany's own borders. The air attack on Japan came very late in the war and was very highly concentrated. From June 1944 to January 1945, only 800 tons of bombs were dropped by China-based B-29's on the Japanese home islands. Following the seizure of the Marianas in August 1944, a series of bases for long-range bombers were constructed, but the tonnage dropped by 9 March 1945 totaled only 7,180 tons.

The basic revision in the method of B-29 attack came on 9 March 1945, when it was decided to bomb the four principal Japanese cities

at night with incendiaries. The first attack burned out 15 square miles of Tokyo's most densely populated area. This enormously destructive attack was followed almost immediately by strikes on Nagoya, Osaka, and Kobe. In the aggregate 104,000 tons of bombs were directed at 66 Japanese urban areas, or about two-thirds of the total tonnage dropped on the home islands. Far smaller tonnages were directed against selected industrial and military targets, as follows: 14,150 tons against aircraft factories, 10,600 tons at oil refineries, 4,708 tons against arsenals, 3,500 tons against miscellaneous industrial targets, 8,150 tons at airfields, and 12,054 mines used in the attacks against shipping.

B. Effects of the Attacks

The physical destruction resulting from air attacks on Japan was approximately the same as that suffered by Germany. The attacks were more concentrated in time, and the target areas in Japan were smaller and more vulnerable. Japan's defensive capabilities were overwhelmed as was its will and capacity for reconstruction and dispersal. Some 40 percent of the built-up area of the 66 cities attacked was destroyed, and about 30 percent of the entire urban population lost their homes. Total civilian casualties as the result of nine months of air attack, including an estimated 200,000 from the atomic bombs, were approximately 806,000. These casualties probably exceeded those which Japan suffered in combat.

The economic effects of the air attacks are difficult to specify because the loss of merchant shipping had essentially isolated Japan from its sources of industrial raw materials. Most of the oil refineries were out of petroleum, the aluminum plants were out of bauxite, the steel mills were short of ore and coke, and the munitions plants were low on steel and aluminum. Japan's economy was in large measure being neutralized twice over, first by cutting off imports and second by air attack.

The railroad system was not subject to substantial attack and was in reasonably good operating condition at the time of surrender. Japan's electric power system had not been selected as a target system, largely because it existed in numerous small production facilities. Therefore, most of Japan's generating and distribution capacity remained operable. An exception was in the urban areas which had been subject to heavy incendiary attack.

C. Civilian Morale

The early Japanese military successes, particularly the capture of Singapore, were followed by a wave of optimism and high confidence on the part of the Japanese people. As the war progressed, subsequent defeats were studiously withheld from the people or disguised as strategic withdrawals. The US Strategic Bombing Survey reported that as late as June 1944 in spite of an increasing shortage of food and exhausting work to support the war effort, only about 2 percent of the Japanese population

believed that Japan faced the probability of defeat. The beginnings of attacks on the home islands coupled with military defeat in the Philippines and a continuing deterioration of food supplies began to be reflected in sharply lowered civilian morale. The survey reported that by June of 1945 nearly half of the Japanese people believed that victory could no longer be achieved. One striking effect of air attack on the cities was the mass evacuation which resulted. Roughly one-fourth of the urban population either fled or was evacuated. Progressive lowering of morale was characterized by loss of faith in military and civilian leaders, loss of confidence in Japan's military might, and increasing distrust of government news releases. The interrelationship of military, economic, and morale factors was a complex one, in which the urban attacks had played an important role. It should also be remembered that the effect of the atomic bomb was severe not only on the civilian population but also on the civilian and military leadership.

D. Destruction of Japanese Merchant Shipping

Japan's merchant fleet was a key link in supplying home industry with raw materials as well as being vital to the support of armed forces in the field. Approximately 9 million tons out of a total availability of 10 million tons of merchant shipping (including ships of 500 tons and over) was sunk or seriously damaged during the war. About 55 percent of this loss was from submarines and approximately 10 percent from mines, most of which were dropped by aircraft. Most of the remainder fell victim to direct air attack. Thus, the role of airpower in the isolation of the Japanese home islands was a major one, even though it was secondary to that of the submarine (see Figure E-2).

As a maritime nation with large domestic and foreign trade, Japan had developed a modern merchant marine of first rank. Because shipping was highly developed and heavy industry was located to use fuel and raw materials received by water routes, the railroad mileage was small and the rail system of limited capacity. Only two main rail lines extended the length of Honshu Island. The fleet of large ocean-going ships was complemented by numerous smaller craft engaged in the coastal trade in and around the home islands.

The conquest of Southeast Asia gave Japan control of most of the world's supply of rubber, tin, antimony, jute, and quinine as well as sources for more than enough of its own requirements of petroleum, iron ore, bauxite, sugar, corn, and rice. During the war, Japan drew heavily on this area for the bulk raw materials needed by its industry.

Despite a vigorous building program, Japan after 1942 was not able to maintain the prewar level of total tonnage of merchant ships afloat. The December 1941 level was 5.4 million tons of merchant vessels, excluding tankers. A year later, this total had been reduced to 5.2 million tons, and by December 1943 the combination of submarine

and air attacks had lowered ship availability to 4.2 million tons. The submarine offensive had been particularly stepped up in the fall of 1943.

The year 1944 saw the beginning of the devastating carrier attacks on merchant shipping, originally as a result of the carrier raids on Truk and Palau. A series of operations involving the invasion of the Mariannas and the pre-invasion carrier raids around the Philippines followed in the summer and the fall. Sorties against merchant shipping flown by Army, Navy, and Marine land-based and carrier-based aircraft increased from 118,000 in 1943 to 327,000 in 1944. In 1945 the combined sorties reached a monthly peak of almost 51,000 in April. During 1944 the merchant tonnage afloat had been reduced over 50 percent in a 12-month period and was only about 1.5 million tons when Japan surrendered.

Other air operations had a significant effect in reducing the mobility of the shrinking merchant fleet despite Japan's willingness to take severe shipping losses because of its desperate need for strategic imports. The mine-laying campaign conducted by the B-29's early in 1945 not only reduced the total tonnage of merchant shipping but also blockaded certain ports and greatly reduced the serviceability of others.

Oil imports passed their peak in August 1943. The Japanese Navy had lost a significant number of its tankers at Truk, and further sinkings of tankers created desperate shortages of fuel by the fall of 1944. By April 1945, tanker imports ceased completely. Stocks had been drawn down and were quickly exhausted, the fuel supply for the shipping industry began to dry up, and a considerable tonnage of smaller vessels was laid up by lack of petroleum. Despite the accumulation of stockpiles of industrial raw materials, even the direct munitions industries suffered serious losses in output as a result of the interdiction of merchant shipping. For example, aluminum output declined 76 percent in a single year as a result of the stoppage of bauxite imports.

Finally, the nation became short of food. Local production had declined, partly as a result of cutting off imports of fertilizers. Fishing, a major industry prior to the war, was reduced by 50 percent for a variety of reasons, including requisitioning of ships by the Japanese Navy and the shortage of fuel. The situation became so acute by April 1945 that virtually all of the small remaining shipping capacity was diverted to the import of food and salt, sacrificing the trickle of industrial raw materials that had still been flowing in. By April 1945, Japan was essentially isolated. The raw materials base of its economy had been cut off, and the country could look forward only to gradual starvation and increasing military impotence.

E. Actions of the Elite to End the War

Although in theory the Japanese Emperor was the sole authority, in practice he usually approved the decisions of his advisers. During

the early years of the war these advisers were dominated by fanatical army and navy officers. The first definite breach in the political coalition did not occur until Japan's defeat at Saipan. Ten days later, on 16 July 1944, the Cabinet headed by General Tojo fell.

Tojo's government was succeeded by one headed by General Koiso. Despite the original instructions to the Cabinet to give "fundamental reconsiderations" to the problem of continuing the war, Koiso was unable to stand up to the more determined military officers. His major accomplishment was setting up a Supreme War Direction Council which was the inner cabinet group through which the problem of surrender was eventually resolved.

The conviction and strength of the peace party was increased by continuing Japanese military defeats after Saipan and by Japan's inability to defend its airspace against attacks in late 1944 and early 1945. After the US landing on Okinawa in April 1945, General Koiso was replaced by Admiral Suzuki.

In May of 1945 the Supreme War Direction Council began active discussions on ways and means to end the war. The Council initiated discussions with the Soviet Union seeking mediation. On 20 June 1945 the Emperor on his own initiative called the Supreme War Direction Council together and ordered it to develop a plan to end the war.

August brought the decisive steps, with the atom bomb falling on Hiroshima on the 6th and the USSR entering the war on the 9th. The Emperor quickly resolved the conflict in favor of unconditional surrender.

In retrospect, it is clear that, at the highest levels within the Japanese Cabinet, the movement to bring the war to an end began over a year earlier than the date of the final surrender. Japan's surrender cannot be imputed solely to any one of the numerous reversals which jointly contributed to the final decision. The military reversals in the field; the destruction of the Japanese fleet and merchant marine, which isolated the home islands; the surrender of Germany; the destruction caused by incendiary and atomic weapons; and, finally, the Soviet decision to enter the war, all played a part.

III. The Air War Against North Korea

A. Introduction

The lessons learned in one war against an adversary using strategy and tactics appropriate to the time and place cannot often be applied with success to another war fought under different conditions. Improved weapons alone can negate the lessons of an earlier war. Furthermore, each war is unique in its total setting -- the political and economic realities of a North Vietnam are not those of a North Korea any more than the tropical setting of the former is equal to the harsh climate of the latter.

This appendix reviews the environment of the two wars and places particular emphasis on the attempts by US aviation forces to interdict the transportation system and to destroy the heavy industry of North Korea. In spite of the differences between North Korea and North Vietnam, these aspects of US operations in North Korea are relevant to current US air operations in North Vietnam.

B. Similarities and Differences of Environment

Numerous similarities exist between the present war in Vietnam and the Korean War. Each conflict involves a divided country. Communist China looms over the northern border of both North Korea and North Vietnam as a major supplier of war materiel and as a participant or potential participant. Many contrasts exist also. The topographic and climatic setting of the military actions in South Vietnam are unlike those fought in Korea. Instead of the guerrilla and infiltration tactics characteristic of today's war in South Vietnam, the Korean War eventually involved large-scale land armies.

Other contrasts can help put the two conflicts in perspective. North Korea occupies an area of about 47,000 square miles and in 1953 had a population of 9 million; North Vietnam has an area of 61,000 square miles and a population of 18 million.

C. Interdiction in North Korea

1. Introduction

In the summer of 1951 as talks about a truce began and the fighting lulled, the US Eighth Army calculated that enemy forces in Korea were stockpiling daily 800 tons of supplies behind their lines. It was feared that the enemy would "reach a degree of preparedness previously unparalleled in the Korean War." To interfere with this buildup, the Far East Air Force (FEAF) planned Operation Strangle, a comprehensive interdiction campaign against North Korea's railroads and highways.

Operation Strangle had two principal objectives: (1) the knocking out of the North Korean rail system by maintaining continuing rail cuts at numerous points and by destroying rolling stock and equipment, and (2) the disrupting of rail services so that the North Korean and Chinese Communist forces would have to use the highways, which could be brought under effective attack, to transport most of their military supplies.

Postmortems on Operation Strangle have claimed that the codename was an unfortunate choice because it implied more than had been intended. Nevertheless, that name mirrors initial Air Force optimism about the probable effectiveness of an interdiction program. For example, one official statement at the beginning of Operation Strangle claimed:

The Fifth Air Force and attached units in conjunction with US Naval Air units and FEAF Bomber Command have the capability of destroying the enemy's rail system in North Korea, and of hindering his highway transportation system to such an extent that he will not be capable of opposing the US Eighth Army effectively.

Starting in August 1951 and extending over the next 11 months, 81,600 interdiction and armed reconnaissance sorties were flown by the USAF, and more than 104,000 tons of bombs were dropped during the interdiction and armed reconnaissance sorties.* By contrast, in a similar time period (February-December 1965) in North Vietnam, 27,900 sorties were flown and 34,300 tons of bombs, napalm, and rockets were expended against fixed and armed reconnaissance targets. During Operation Strangle an average of almost 10,000 tons of bombs were dropped monthly. The peak month for Rolling Thunder occurred in December 1965 when 5,500 tons of bombs, napalm, and rockets were expended. A summary comparison of air operations in the Korean War and in North Vietnam (Rolling Thunder) is presented in Table E-2.

Operation Strangle was not, however, the first US attempt at interdiction in Korea. In the first year of the Korean War the Air Force had flown 70,000 interdiction and armed reconnaissance sorties out of a total of 140,000 combat sorties, but the fluid military situation had required that major emphasis be given to close support of combat troops.

* Because of its unfortunate codename there was considerable controversy (during the Korean War) about the timespan covered by Operation Strangle. The time limits used in the official Air Force history are used in this Appendix. Thus Operation Strangle (later Operation Saturate) began in August 1951 and continued through June 1952.

2. Railroad Interdiction -- Operation Strangle

For the first three months, Operation Strangle was successful. Major rail lines were disrupted, and fighter-bombers destroyed railroad track faster than the enemy could rebuild it. By early October 1951, rail movements ceased, even on the double-tracked line from the capital of P'yongyang south to Sariwon just north of the battle zone. By November 1951, virtually all direct major rail routes to Manchuria had been severed, although limited serviceability existed by shunting traffic inland and then back to either coastal or other interior rail lines. Interdiction and armed reconnaissance accounted for over 60 percent of all combat sorties from the start of Operation Strangle through the end of 1951. The numbers of sorties flown and bomb tonnages expended reached a peak in October, when 9,700 interdiction and armed reconnaissance sorties were flown and more than 10,000 tons of bombs were dropped. In the first two months of Operation Strangle, interdiction and reconnaissance targets claimed more than 90 percent of the total weight of bombs dropped.

These attacks reached a peak of destructiveness in September through November 1951. In September, Air Force pilots alone claimed the destruction of 38 locomotives, 558 freight cars, 5,400 vehicles, and about 1,400 buildings. Rail lines were severed about 15,000 times.*

Immense damage was done to the transportation system of North Korea, even when allowance is made for the exaggerated claims of destruction. The first intense blows did not knock out the system, however, and in the following months the serviceability of the North Korean transport system improved materially. Tonnages being moved on the railroads and highways were only a small fraction of peacetime "capacity," but the supplies getting through were more than sufficient

* The official USAF Historical Study of Air Operations in the Korean War recognizes that pilot's claims of vehicles destroyed were greatly exaggerated, the results of night attacks being especially hard to evaluate or check. In September 1951 the Fifth Air Force issued a directive permitting night intruders to claim enemy vehicles destroyed only when the vehicles were seen to burn or explode. Yet even this requirement probably did not prevent multiple claims. For example, North Korean truck drivers carried oily rags which were lighted when they were under attack to feign destruction and be spared further attack. Eventually, claims of locomotive "kills" were only allowed when attacks were made using 500-pound bombs or larger and after which the locomotive was observed to be derailed or in at least three separate parts.

Table E-2

Comparison of Air Operations in Korea and North Vietnam

	Korean War ^{a/}		North Vietnam
	Entire War June 1950 - July 1953	Operation Strangle August 1951 - June 1952	Rolling Thunder February - December 1965
Sorties			
Total	710,886	214,485	N.A.
Total combat ^{b/}	461,554	144,724	N.A.
Total interdiction and armed reconnaissance ^{c/}	220,168	81,613	25X1
Total combat expenditures			27,932 ^{d/}
Bombs (tons)	386,037	118,207	N.A.
Napalm (tons)	32,357	4,313	N.A.
Rockets (rounds)	313,600	50,707	N.A.
Expenditures for interdiction and armed reconnaissance			
Bombs (tons)	218,448	104,115	} 34,261
Napalm (tons)	3,815	2,192	
Rockets (rounds)	97,885	30,492	
Damage ^{e/}			
Bridges			
Destroyed	1,153	223	161
Damaged	3,049	763	432

Table E-2
Comparison of Air Operations in Korea and North Vietnam
(Continued)

	Korean War ^{a/}		North Vietnam
	Entire War June 1950 - July 1953	Operation Strangle August 1951 - June 1952	Rolling Thunder February - December 1965
Damage (Continued)			25X1
Tunnels			N.A.
Destroyed	65	41	N.A.
Damaged	939	257	
Locomotives			6
Destroyed	963	272	6
Damaged	1,171	345	
Freight cars			227
Destroyed	10,407	3,638	592
Damaged	22,674	7,069	
Railroad cuts	28,621	24,251	N.A.
Trucks and other vehicles			483
Destroyed	82,920	33,210	565
Damaged	33,131	14,768	
Buildings			1,837 f/
Destroyed	118,231	9,109	2,266 f/
Damaged	88,461	17,382	

Table E-2
(Continued)

	Korean War ^{a/}		North Vietnam
	Entire War June 1950 - July 1953	Operation Strangle August 1951 - June 1952	Rolling Thunder February - December 1965
Damage (Continued)			
Oil storage tanks			
Destroyed	16	0	25X1 ^h .
Damaged	3	0	N.A.
Barges and boats			
Destroyed	593	225	460
Damaged	821	284	753
Aircraft			
Average inventory			
Bombers, light	192 ^{g/}	150 ^{h/}	
Bombers, medium	118 ^{g/}	103 ^{h/}	
Fighters	1,511 ^{g/}	982 ^{h/}	
Operational losses ^{i/}			
B-26	168	57	
B-29	57	24	
F-51	300	98	
F-80	277	67	
F-82	11	2	
F-84	249	121	
F-86	184	66	

Table E-2

Comparison of Air Operations In Korea and North Vietnam
(Continued)

- a. Excluding sorties flown by the US Navy and Marines and by other friendly forces. During the Korean War, Navy and Marine aircraft flew 275,912 combat sorties: 204,995 offensive, 44,160 defensive, and 26,757 reconnaissance. Ordnance expenditures were 178,399 tons of bombs and 274,189 rounds of rockets. Navy aircraft were heavily engaged in Operation Strangle, but no specific data, comparable to USAF statistics, are available.
- b. Including close support, strategic, counter-air-offensive, counter-air-defensive, reconnaissance, and interdiction and armed reconnaissance, but excluding combat support sorties such as rescue, cargo, and tactical control.
- c. A mission with the primary purpose of penetrating enemy lines and destroying ^{25X1}damaging traffic, communications, and movement significant to the enemy's military operation in a given area.
- d. Including 6,928 sorties against fixed targets and 17,129 armed reconnaissance sorties.
- e. In addition, Navy and Marine aircraft destroyed during the Korean War: 2,005 bridges, 391 locomotives, 5,896 freight cars, 7,437 vehicles, and 44,828 buildings.
- f. Barracks, warehouses, and miscellaneous buildings.
- g. Peak average inventory, April-June 1953.
- h. Average inventory, July-September 1951.
- i. In addition, 564 Navy and Marine aircraft were lost to enemy action between 25 June 1950 and 27 July 1953.

25X1

E-20

to support the Communist armies in the field. The North Koreans and Chinese developed an increasing capability to repair damage from air attacks and to get both rail and highway traffic moving again. Repairs were being made so rapidly that by late December 1951 the Fifth Air Force recognized that "the enemy had broken our railroad blockade of P'yongyang and ... [has] won the use of all key rail arteries."

In February 1952, Operation Strangle (renamed Operation Saturate) was modified to reflect the lessons of the previous six months. Railroad interdiction was still emphasized, but attacks were concentrated against specific pre-targeted segments of the rail line. The change in air operations, and its successes and failures, can be seen in a description of one attack made against the rail line between Chongju and Sinanju. In a leadoff attack in late March 1952, 307 fighter-bombers dropped 530 1,000-pound bombs and 84 500-pound bombs. The following day, 160 fighters dropped 322 1,000-pound bombs. During the night, B-26's dropped 42 500-pound bombs on what had already become a major gap in the rail line. However, the ability of the North Koreans to repair rail damage had further improved; within six days the roadbed was almost completely rebuilt and the tracks were replaced. The 48-hour attack and the expenditure of 450 tons of bombs had interdicted the rail line for 6 to 7 days but had required the commitment of almost the entire fighter-bomber force. At the same time other rail lines had remained open.

In April 1952 a penetrating staff study by the Air Force recognized that in spite of the vast damage inflicted the interdiction operation had not achieved its objectives and that such operations were becoming more costly in terms of casualties to air crews and aircraft lost and damaged. Furthermore, some of the most modern US weaponry was being effectively countered by hordes of unskilled labor and minimum amounts of easily attainable materials.

Policy changes which emerged from the staff study emphasized the need to inflict maximum damage on the enemy and to minimize US losses, and included some shifts in targets. Thus, while locomotives, motor vehicles, and other transportation targets were still rated as prime targets, equal or greater emphasis was given to radar, guns, supply depots, mines, powerplants, and military schools. In effect, the new targeting took account of economic principles. From attempts to physically cut the rail and highway systems the attack moved to inflict maximum damage upon the enemy's limited stock of military and transport capital in North Korea, capital which could not be replaced by the labor of unskilled peasants. Nevertheless, the new attack policy, announced in July 1952, admitted that "obstruction of enemy supply movement in Korea cannot prevent the enemy from gradually building up his stockpile." Although the Air Force continued to bomb selected bridges and rail targets during the remaining year of the war, Operations Strangle and Saturate were at an end.

3. Evaluation of Operation Strangle

a. Introduction

Operation Strangle and Operation Saturate failed to achieve their objectives not only because there was an insufficient number of aircraft to maintain an adequate number of rail cuts but also because enemy countermeasures were more successful than had been estimated. Communist antiaircraft defenses increased markedly, and the Communists showed an increasing ability to improvise repairs, to build bypass lines, and to mass peasant labor to maintain and repair essential supply lines.

The decline in returns from Operation Strangle can be seen from an analysis of bombs expended and damage achieved. During July 1951, the month before Operation Strangle got under way, approximately 6,600 tons of bombs had been dropped on interdiction targets in North Korea. Bombs expended increased sharply in August to 8,300 tons. From August to September, bombs expended increased by about 2,000 tons, or one-fourth, and the estimated value of destruction increased by about three times. After November, however, there was a steady trend of diminishing returns from the bombing attacks despite a fairly steady expenditure of bombs at an average rate of 9,800 tons per month. As shown in Figure E-3, the index of value of damage per ton of bombs declined from a peak of 100 in September 1951 to 39 in January 1952 and a low of about 26 in April and June.

b. Railroad Interdiction

During 1950-53 the North Korean rail system consisted of about 2,300 miles of line, largely standard gauge, and included approximately 1,800 bridges and 400 tunnels. During the initial stages of Operation Strangle the Air Force engaged in a multiprong attack against bridges, rolling stock, tunnels, roadbeds, and rails. Tunnels, used extensively to protect trains and supplies in daytime attacks, proved in most instances to be impossible to destroy. Bridges were difficult targets, but were destroyed consistently.

After the interdiction campaign had been under way for several months the enemy showed a rapidly increasing capability to restore damaged bridges. Construction materials were being stockpiled near key bridges even before US attacks. Simple bypass bridges were built frequently in from 2 to 4 days. Rail cuts were repaired in from 2 to 6 hours. Priority was placed on getting a bridge back in partial operation so that some supplies could begin to flow again although traffic might remain far below capacity levels.

The North Koreans and Chinese stationed railroad construction troops along all main supply routes which were under attack. Units of 50 troops were located at all major rail stations,

and crews of 10 men were located every 4 miles along the route. In addition, rail walkers spotted damage to the rail or roadbed. Nearby inhabitants were recruited for common labor, and sometimes as many as 1,000 persons were used to repair a damaged section. At dark, experienced railroad construction crews would move in and make the actual repairs to the rail line. Furthermore, in portage-like operations, rail service was maintained on very short stretches of usable track -- as short as 11 miles -- and freight was unloaded, carried around rail cuts or damaged bridges, and then reloaded on another train.

c. Highway Interdiction

The road network in North Korea, originally developed by the Japanese, had always been of secondary importance to the railroads. Trucks had been used typically for short hauls and served as links between industrial and commercial centers and the major railroads. North Korea's principal highways roughly followed the major rail routes from Manchuria southward. Altogether about 10,000 miles of highways existed, at best surfaced with gravel or crushed stone.

Although the major interdiction effort of Operation Strangle was against the North Korean rail system, attacks against trucks were also pressed, especially night attacks led by B-26's. On one occasion, an Air Force wing reportedly sighted 3,800 motor vehicles and attacked 2,600 vehicles in one day. The Air Force claimed that 6,400 trucks were destroyed in October 1951 alone. Highway bridges were also attacked but proved to be more difficult to interdict effectively than rail bridges. Bypasses were sometimes built at a considerable distance from the original bridge and were thus not easily sighted; fords were built and used during much of the year.

Truck traffic was uncommon during the daylight hours and at night was hard to locate and to attack effectively. The results of night attacks against motor vehicles as well as rolling stock were especially difficult to assess. Trucks usually traveled in convoys of 15 to 20 vehicles, ordinarily under blackout conditions. The mileage norm for trucks per night was about 60 miles. For example, a round trip from the Manchurian border to the battle zone required about 10 nights' travel.

d. Night Operations

Even before Operation Strangle began, the North Koreans had started to move virtually all rail and road traffic at night. The B-26 bomber was used extensively as a night intruder to harass trucks and trains along major enemy supply routes. During Operation Strangle, 1,500 to 2,000 sorties were flown monthly by B-26 bombers, about 90 percent of them at night. The heavier B-29 bombers were used to attack targets at night.

In the absence of bright moonlight, B-26 attacks achieved only limited success, and numerous experiments were conducted with flares to light the targets. Infrared detection systems were used on a limited scale to locate targets such as locomotives, tanks, vehicles, and industrial locations. The results of these innovations were limited, however.

In 1952, as Operation Strangle disrupted railroad lines, the North Koreans and Chinese made more intensive use of trucks to transport supplies to the front. In the fall and winter months, sightings of vehicles declined, and the B-26 night attacks were shifted to rail cutting and to harassing North Korean night repair activities.

The major lessons from US night-intruder operations during the Korean War were the following: (1) aircraft, especially the B-26 that had been designed for day operations, had only limited success at night in detecting, identifying, and attacking moving targets; (2) air crews required careful selection and special training for night operations; and (3) a strong need existed for a family of "denial" weapons that would successfully interdict rail lines and highways for periods that would eliminate the need for essentially inefficient night operations. Night operations were hampered throughout by the inadequacy of night photography to provide adequate assessment of bomb damage.

e. The Wa-dong Chokepoint

The Korean War offers an excellent example of the difficulty of successfully interdicting a transportation chokepoint by large-scale aerial bombing. In the winter of 1952, while Operation Saturate was getting under way, target specialists located what appeared to be a vital chokepoint near the village of Wa-dong in central Korea about 20 miles north of the 39th parallel. Here a major east-west railroad passed over a highway from Wonsan on the east coast to the capital at P'yongyang. About 100 yards further to the west the railroad entered a short tunnel. The railroad and highway did not follow identical alignments across North Korea but came together only at Wa-dong. Adjacent hills rising to about 300 feet above the valley floor would have made Wa-dong stand out as an ideal chokepoint to even the most unimaginative target analyst. The North Koreans had used both the lateral highway and the railroad to shuttle supplies between the east and west coastal railroads, thus substantially increasing the flexibility of the badly damaged rail system. The objective of the attacks was to block all rail and vehicle movement in the area. Due to the area's rough terrain, bypassing the chokepoint would have proved very costly.

For 44 days, from 26 January to 11 March 1952, 77 B-29 and 126 B-26 sorties saturated the target of about 18 acres with

3,928 500-pound general-purpose bombs, one bomb for every 22 square yards of target. Bomb assessment reports for 24 days of the 44-day attack period showed the following results:

Railroad

Serviceable	10 days
Unserviceable	8 days
Status unknown	6 days
Total	<u>24</u> days

Highway

Serviceable	15 days
Unserviceable	4 days
Status unknown	5 days
Total	<u>24</u> days

Bomb assessment reports also revealed that the total effort had resulted in only 18 actual rail cuts and 15 highway cuts. The effort at best resulted in the railroad being interdicted for 8 days and the highway for 4 days. Except for temporary disruptions the North Koreans had suffered very little damage. The bombs had done little more than churn up the countryside; landslides that had been hoped for did not occur.

Evaluations made of the Wa-dong experience during the Korean War led to the conclusion that it is a fallacy to assume that there is an "area target" for traffic interdiction, and the Far East Air Forces recommended that airpower be concentrated on pinpoint bombing against definite targets in preference to area bombing in any future interdiction attacks.

D. Strategic Bombing

1. Early Bombing

North Korea's modern industry, which was developed by the Japanese, was considerably greater in total capacity and range of output in 1950 than North Vietnam's industry in 1965. During the initial months of the Korean War the B-29's available in the war theater were engaged in close tactical support of the hard-pressed US and South Korean forces. Attacks on industrial targets in North Korea were not feasible until mid-July 1950. In the next three months the FEAF Bomber Command dropped 10,400 tons of bombs, with excellent results, on the major targets listed below in Table E-3.

Table E-3

Strategic Targets Attacked in North Korea
1950

Location	Target	Bomb Tonnage	Percent of Target Destroyed or Damaged
Wonsan	Dock area	244	50
	Locomotive shops	372	70
	Railroad yards	477	70
	Chosen oil refinery	327	95
Hungnam	Bogun Chemical Plant	695	70
	Chosen Nitrogen Fertilizer Company	563	85
	Chosen Nitrogen Explosives Company	500	85
P'yongyang	Arsenal	99	70
	Kan-Ni	500	15
	Shunting yards	356	30
	Railway shops and yards	584	70
Chongjin	Harbor and submarine base	249	5
	Mitsubishi	132	30
Chongjin	Iron works	203	20
	Railroad yards and shops	1,063	55
Rashin	Oil storage	49	Negl.
	Dock area	218	Negl.
	Railroad shops and yards	110	Negl.
Chinnampo	Marshaling yards	121	80
	Port and subbase	5	Negl.
	Mining and smelter	248	35
	Chosen Riken Metals Co.	284	70
Changjingang Reservoir	Pujon Hydroelectric Plant No. 1	39	10
Hamhung	Railway shops and yards	547	70
Haeju	Chosen Nitrogen Explosives Company	568	10
	Railway shops and yards	104	70

Table E-3

Strategic Targets Attacked in North Korea
1950
(Continued)

Location	Target	Bomb Tonnage	Percent of Target Destroyed or Damaged
Kjomipo	Iron works	252	40
	Marshaling yard	23	Negl.
Kowon	Railway shops and yards	102	10
Songjin	Steel works	326	90
	Magnesite Chemical Industry	183	30
	Railway shops and yards	280	60
Yangdok	Railway shops and yards	75	85
Namgunni	Storage area	58	80
Munpyongni	Rising Sun Oil Storage	2	a/
Chongju	Railway shops and yards	170	10
Kilchu	Marshaling yards	99	50
Sunchon	Chemical industry and marshaling yard	138	30
Sariwon	Marshaling yard	81	50
Total		<u>10,446</u>	

a. No bomb damage assessment.

Of 20 strategic targets designated by the JCS, 18 had been destroyed or severely damaged by late September.

In September 1950, plans were under way to destroy the modern complex of hydroelectric generating plants that had been built by the Japanese. On 26 September, 17 B-29's attacked and inflicted minor damage on the Pujon Hydroelectric Plant, which had an installed capacity of 128,000 kilowatts. The same day, however, the JCS suspended attacks on strategic targets.

By late September the Commander of FEAF was able to claim, "Practically all of the major military targets strategically important to the enemy forces and to their war potential have now been neutralized." In a few weeks, North Korea's modern industry had been destroyed. Although such destruction obviously inflicted "punishment" on North Korea's leadership, the military effect of the strategic bombing was of little consequence. Military equipment and ammunition continued to flow into North Korea from China and the USSR.

2. Later Strategic Bombing Efforts

a. Hydroelectric Power

It was not until June 1952 that the hydroelectric installations previously regarded as "politically sensitive" targets were again considered as legitimate targets. Over a 3-day period in June 1952, 730 fighter-bomber sorties by the Fifth Air Force, supported by sorties from a Navy Task Force, were flown against the power complexes, including the Sui-ho Generating Plant on the Yalu River. Post-strike evaluation of the bombing attack indicated that 90 percent of North Korea's electric power capacity had been knocked out. For more than two weeks there was almost a complete blackout in North Korea until small thermal plants and undamaged hydroelectric plants restored a small portion of North Korea's pre-attack capacity. Although the small, dispersed "war-industries" in North Korea obviously suffered from the loss of electric power, the extent of the damage to industry in Manchuria, which received much of its electric power from North Korea, was difficult to assess.

Attacks against the hydroelectric installations came much too late in the Korean War to have much impact on the outcome or to do serious damage to North Korea's war effort. The attacks were designed primarily to exert continued air pressure on the North Koreans and Chinese to accept UN truce proposals.

b. Irrigation Dams

In the spring of 1953, only slow progress was being made at the Panmunjom truce talks. Air Force targets specialists seeking additional means of increasing air pressure against the

Communists recognized the importance of the irrigation dams to Korean rice production. There followed a large-scale and highly successful attack against a 2,300-foot earth and stone dam about 20 miles north of P'yongyang. Along with severe damage to a major rail line, the floodwaters also damaged 5 square miles of prime rice crops.

Other Korean dams were attacked by US fighter-bombers and B-29's, ostensibly to interdict transportation lines. These later attacks were less successful because the North Koreans, as in other circumstances, improvised countermeasures. For example, by rapidly lowering the water level the North Koreans made it much more difficult to destroy or seriously damage the dams.

E. Lessons from the Korean War

1. Introduction

The 27,900 sorties flown and the 34,300 tons of bombs, napalm, and rockets expended under the Rolling Thunder program from February through December 1965 are less than one-third the 81,600 sorties flown and the 104,000 tons of bombs dropped by the Air Force during the interdiction and armed reconnaissance sorties in the 11 months of Operation Strangle. In addition, during the Korean War Navy and Marine aircraft operating from carriers probably also dropped about one-third as much tonnage as was dropped by the Air Force on interdiction targets.

Even allowing for exaggerated damage claims, it is clear that there were far more lucrative targets in North Korea than are being located and destroyed presently in North Vietnam. Destruction claimed in the 11 months of Operation Strangle in Korea compared with that claimed for Rolling Thunder in Vietnam through December 1965 is shown in the following tabulation:

	<u>Operation Strangle</u>	<u>Rolling Thunder</u>
Locomotives	272	6
Freight cars	3,638	227
Vehicles	33,210	483
Bridges	223	161
Buildings	9,109	1,837
Barges and boats	225	460

The greater destruction achieved in Korea compared with North Vietnam is not solely a function of the number of sorties and the tonnage of bombs dropped. The Rolling Thunder program has had to operate under an extremely restrictive policy which sharply limits both the areas in which it can operate and the targets it can attack.

North Korea's railroads and highways had to supply almost 1 million troops, 600,000 of whom were at the front. North Korea had almost 2,300 miles of rail lines and 10,000 miles of highways, compared with North Vietnam's meager 485 miles of rail lines and 5,800 miles of highways. North Korea had a much larger park of both rolling stock and trucks. In addition, although the population of North Vietnam substantially exceeds North Korea's, there was more modern and semimodern industry in North Korea than is found in North Vietnam.

2. Failure of the Interdiction Campaign

At the time Operation Strangle was under way, it was estimated that each Chinese division required 50 tons of supplies per day.* With 60 divisions at the front, approximately 3,000 tons of supplies had to be moved from Manchuria to the battlefield each day.

Peacetime capacity of the double-tracked line in western Korea from Sinuiju to P'yongyang was estimated to have a capacity of from 6,000 to 9,000 tons per day. After maximum interdiction efforts, it was conservatively estimated that only 500 to 1,500 tons per day were getting through to the battle zone. The capacity of the east coast rail line, 5,000 tons per day in peacetime, was reduced to less than 500 tons per day. Thus railroads were still able to transport about one-half of the daily requirements. In addition, the North Koreans and Chinese also relied heavily on trucks and on peasants carrying supplies strapped to A-frames and even bicycles for moving supplies to the front. A staff study completed in April 1952 by two Air Force officers concluded that after seven months of maximum US effort the Communists still were more than meeting minimum supply requirements. The study concluded that the accepted figure for the enemy's minimum supply requirements was 2,700 tons per day under existing conditions but that more than this amount was being received. The staff study also stated that over and above daily requirements the enemy had been able to stockpile approximately 100,000 tons, or a 37-day supply, during the seven months of the rail interdiction program.

Another logistics study from the Korean War illustrates how difficult it is to prevent what was called "seeping resupply." During three months in the winter of 1951-52 the Chinese and North Koreans were firing 15,000 mortar shells per month, or 500 shells a day. Each shell weighed 10 pounds; thus it was possible for a peasant to carry five of them on an A-frame. One hundred peasants arriving at the front from supply depots in the rear could supply all the enemy's daily needs for mortar ammunition. One truck a day could replenish the supply depots.

* About 48 percent food; 22 percent clothing, weapons, and equipage; 10 percent POL; and 20 percent ammunition.

Operation Strangle clearly did great damage to the transport system of North Korea and conceivably prevented Communist China from mounting additional large-scale offensives in Korea. At the same time, it is also clear that the Chinese and North Korean troops received sufficient logistic support to contain the offensive pressures exerted by the Eighth Army. In short, the defensive capabilities of the Chinese and North Koreans showed no sign of collapsing as a result of the interdiction campaign, and indeed the enemy was able to mount sharp battalion-size attacks on occasion.

The air interdiction campaign failed to deny Communist forces the supplies they needed to contain the US Army because the North Koreans and Chinese were able to take effective countermeasures. One major lesson that emerged from the Korean War was that US planners underestimated the effectiveness of the enemy countermeasures. The North Koreans and Chinese showed increasing rapidity in rebuilding damaged rail and road bridges and other key installations. Chokepoints, often given exaggerated importance, were frequently bypassed without undue enemy effort. Darkness shrouded most of the enemy's movements from effective attack. A major lesson of the Korean War was the clearly demonstrated need for the development of a family of weapons that could successfully interdict night railroad and highway traffic.

3. Air Pressure Tactics and Psychological Warfare

It is difficult to judge the overall effect of US interdiction and strategic bombing on the will of the political leadership and the morale of the civilian population of North Korea. There are numerous examples, however, of the North Koreans and Chinese responding with effective countermeasures to each new phase of air operations against North Korea. The North Koreans were able to devise effective means to counteract the program of massive rail interdiction. The North Korean response to the bombing of irrigation dams also illustrates the tenacity and cleverness with which the Communists met new phases of US air operations.

Claims by some historians that air operations were almost solely responsible for the North Koreans and Chinese initially coming to the conference table and finally signing a truce agreement cannot be substantiated.* The Chinese and North Koreans came to the conference table mainly because their total losses accruing from the war had become greater than their total gains, all military, political, and economic factors considered, including losses from air attacks. US airpower played an important role in convincing the Communists to come to terms, but the evidence does not support the view that airstrikes were the decisive factor.

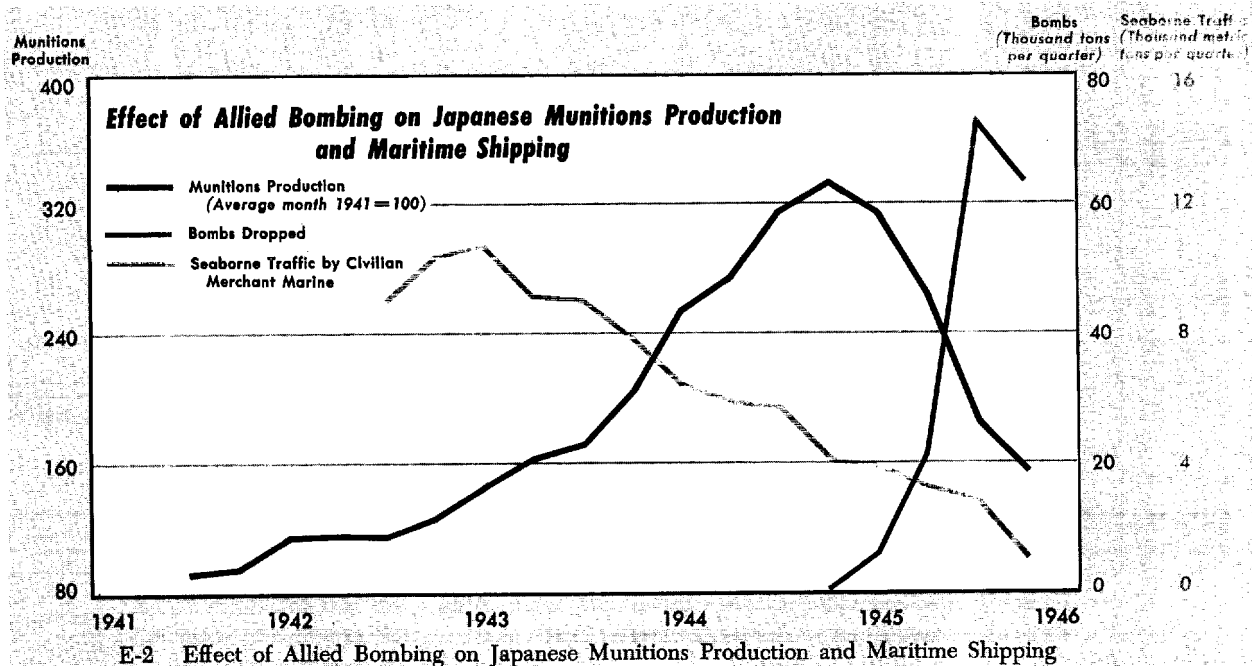
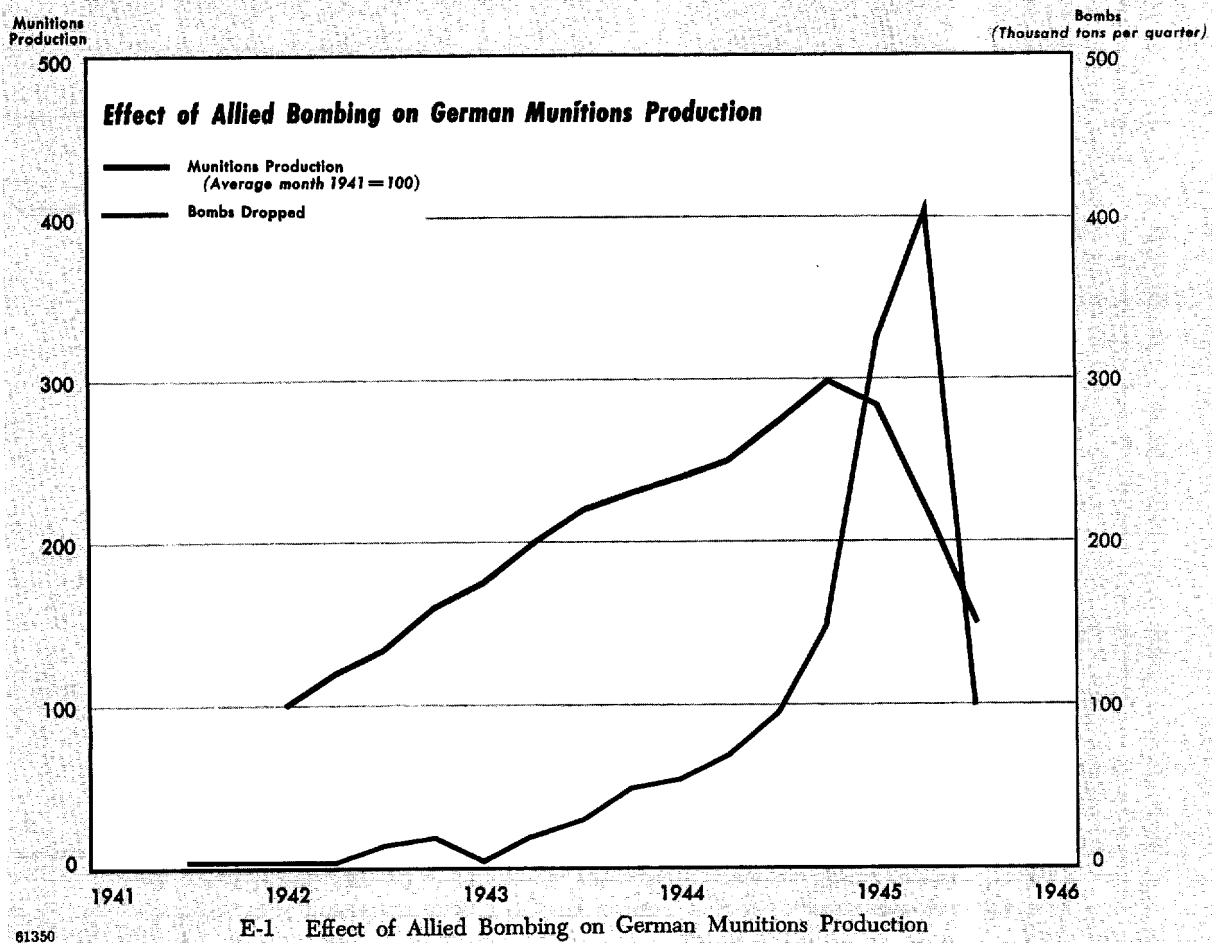
* One Air Force historian, for example, in discussing FEAF operations in Korea in mid-1952, wrote, "the destructive force of FEAF's airpower had broken the stalemate."

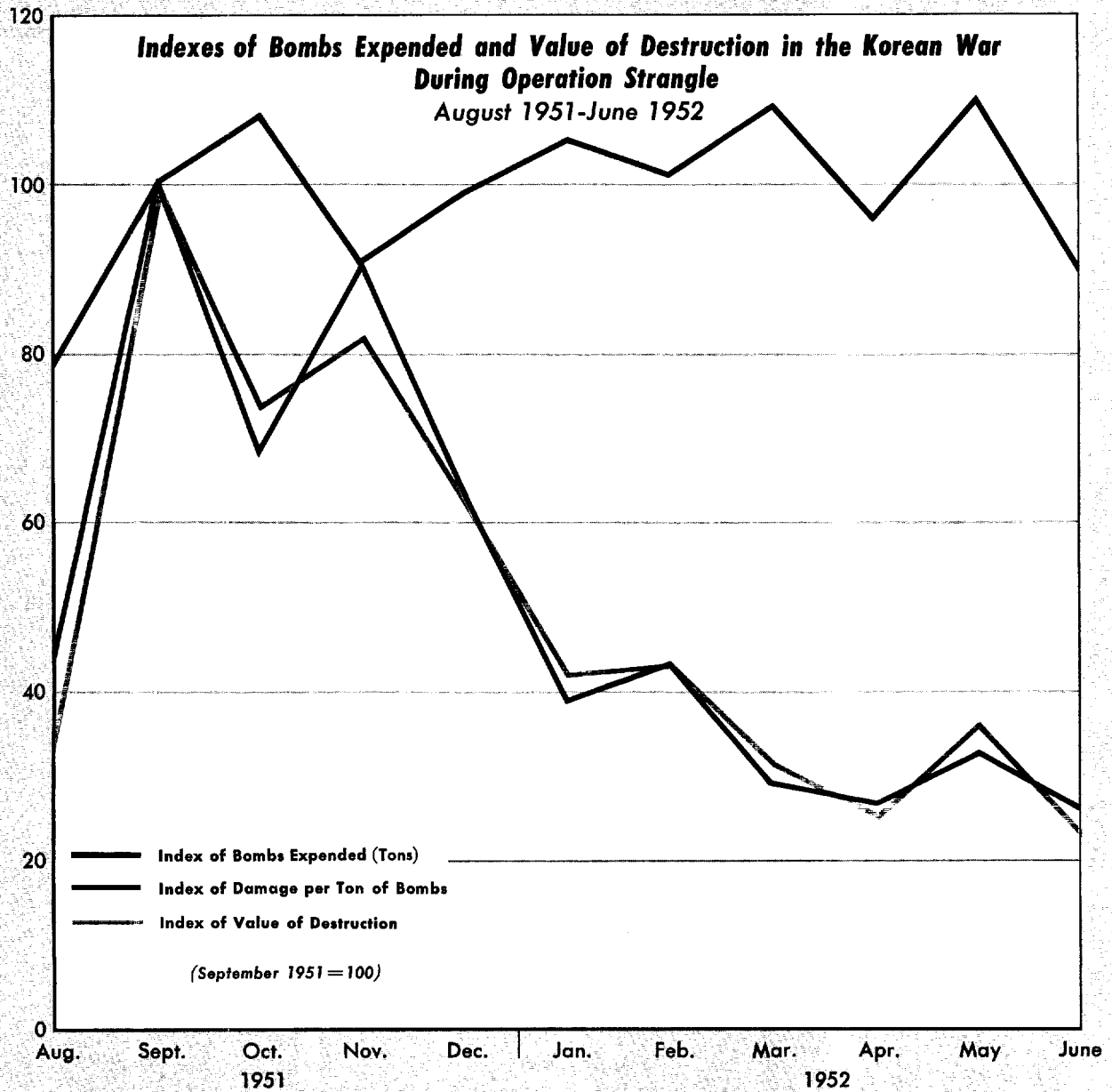
Because of a host of factors, including the unique nature of UN "police action" in Korea and the uncertain position of US officials about the advantages and disadvantages of psychological air warfare, the psychological warfare phase of US operations in North Korea was little understood and only intermittently applied.

4. Lessons for Vietnam

The lessons from the Korean War indicate that it will prove difficult to cut off supplies flowing from North Vietnam to South Vietnam. The total daily tonnages needed by the Viet Cong and North Vietnamese regulars engaged in South Vietnam are far less per man than was the case in Korea, largely because most food and clothing supplies are obtained locally in the South. Relatively small numbers of trucks, carts, and human bearers can maintain more than the enemy's minimum requirements unless the Vietnamese war is sharply escalated. Furthermore, the experiences of the Korean War suggest that as long as they continue to receive support from China and the USSR the North Vietnamese are likely to show an increasing capability to improvise countermeasures to circumvent a continuing US air interdiction. The Korean War suggests also that diminishing returns can be expected from continuing air interdiction. At the same time, the increasing effectiveness of conventional antiaircraft weapons and air defense missiles raises the cost of continuing the campaign. The rebuilding of bridges, the building of bypasses, and the other countermeasures in evidence in North Vietnam in no way suggest a less determined enemy than was encountered in Korea. The primitiveness of North Vietnam -- the lack of potentially decisive military and industrial targets -- will make it difficult if not impossible for airpower alone to extract a prohibitive price for North Vietnamese intransigence. Only the application of large numbers of new interdiction weapons which are more effective than those that were available in the Korean War would tip the scales in favor of successful, long-term interdiction.

The bombing of "strategic" industrial targets in North Vietnam, based on the experience of the Korean War, would probably have little effect on the course of the war. Communist leaders in North Vietnam would almost certainly prefer not to lose the rudimentary modern industry that has been established in recent years. However, the much larger and more diversified industry of North Korea was destroyed in the first three months of the Korean War and neither deterred China from entering the war nor seriously impeded the North Korean military effort. Furthermore, Soviet and Chinese assistance was used to rebuild the damaged plants in North Korea after the war. In North Korea there was not sufficient industry to provide a critical test of the hostage concept of industrial destruction as a means of deterring aggression. In North Vietnam there is even less reason to believe that the loss of a small modern industry would alter the course of the war or make the Communists more prone to negotiate.





E-3 Indexes of Bombs Expended and Value of Destruction in the Korean War
During Operation Strangle

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